

COSMIC DUST CATALOG

(PARTICLES FROM COLLECTION FLAG U2022)

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COSMIC DUST PRELIMINARY EXAMINATION TEAM (CDPET)

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Houston, Texas

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(Particles from Collection Flag U2022)

Compiled by

Cosmic Dust Preliminary Examination Team (CDPET)*

NASA/Johnson Space Center
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1. INTRODUCTION

Since May, 1981, the National Aeronautics and Space Administration (NASA) has used aircraft to collect cosmic dust (CD) particles from Earth's stratosphere. Specially designed dust collectors are prepared for flight and processed after flight in an ultraclean (Class-100) laboratory constructed for this purpose at the Lyndon B. Johnson Space Center (JSC) in Houston, Texas. Particles are individually retrieved from the collectors, examined and cataloged, and then made available to the scientific community for research. Cosmic dust thereby joins lunar samples and meteorites as an additional source of extraterrestrial materials for scientific study.

This catalog summarizes preliminary observations on 128 particles retrieved from collection surface U2022. This surface was a flat plate "flag" (with a 30 cm^2 surface area) which was coated with silicone oil and then flown aboard a NASA U-2 aircraft during a series of flights that were made within west-central North America from April 9, 1984, to June 26, 1984. This flag was installed in a specially constructed wing pylon which ensured that the necessary level of cleanliness was maintained between periods of active sampling. During successive periods of high-altitude (20 km) cruise, the flag was exposed in the stratosphere by pilot command and then retracted into sealed storage containers prior to descent. In this manner, a total of 41.8 hours of stratospheric exposure was accumulated for flag U2022.

Flag U2022 was previously included in a broad sampling of probable cosmic particles (see definition in Section 4) and yielded samples of two such particles, U2022 A3 and U2022 A4, that were described in Cosmic Dust Catalog 6. Additional fragments of the parent particle of these two chondritic particles have been included within this catalog as particles U2022 G1, 2, and 3.

2. PROCESSING OF PARTICLES

Particle mounts designed for the JEOL-100CX scanning transmission electron microscope (STEM) are currently the standard receptacles for CD particles in the JSC laboratory. Each mount consists of a graphite frame (size ~3x6x24 mm) onto which a NucleoporeTM filter (0.4- μ m pore size) is attached. A conductive coat of carbon is vacuum evaporated onto the mount and then a microscopic reference pattern is "stenciled" onto the carbon-coated filter by vacuum evaporation of aluminum through an appropriately sized template. CD particles are individually removed from collection flags using glass-needle micromanipulators under a binocular stereomicroscope. Each particle is positioned on an aluminum-free area of a Freon cleaned, carbon-coated filter and washed in place with hexane to remove silicone oil. Each mount is normally limited to 16 particles. All processing and storage of each particle is performed in a Class-100 clean room.

3. PRELIMINARY EXAMINATION OF PARTICLES

Each rinsed particle is examined, before leaving the Class-100 clean room processing area, with a petrographic research microscope equipped with transmitted, reflected and oblique light illuminators. At a magnification of 500X, size, shape, transparency, color, and luster are determined and recorded for each particle.

After optical description, each mount (with uncoated particles) is examined by scanning electron microscopy (SEM) and X-ray energy-dispersive spectrometry (EDS). Secondary-electron imaging of each particle is performed with a JEOL-100CX STEM operated in the SEM mode and at an accelerating voltage of 40 kV. Images are therefore of relatively low contrast and resolution due to deliberate avoidance of conventionally applied conductive coats (carbon or gold-palladium) which might interfere with later elemental analyses of particles. EDS data are collected with a JEOL-35CF SEM equipped with a Si(Li) detector and PGT-4000T analyzer. Using an accelerating voltage of 20 kV, each particle is raster-scanned and its X-ray spectrum recorded over the 0-10 keV range by counting for 100 sec. No system (artifact) peaks of significance appear in the spectra.

It should be pointed out that the SEM/EDS procedure used in preparing this catalog is different than that used in preparing Cosmic Dust Catalogs, Volumes 1, 2, and 3. In the earlier catalogs, both SEM imaging and EDS analysis were performed using the JEOL-100CX STEM operated at 40 kV. The procedure used for this catalog retains the superior imaging capability of the JEOL-100CX but incorporates the superior EDS capabilities of the JEOL-35CF. The new, two-step process provides the best possible preliminary-quality data while minimizing the electron beam exposure experienced by the samples. Only the EDS spectra exhibit differences that are likely to be

noticed. However, spectra of selected comparison standards that were published in previous catalogs were re-collected under the new procedure and are included in this catalog. Please refer to Section 5 for a more complete discussion.

Following SEM/EDS examination, each particle mount is stored in a dry nitrogen gas atmosphere in a sealed cabinet.

4. CATALOG FORMAT

Each page in the main body of the catalog is devoted to one particle and consists of an SEM image, an EDS spectrum, and a brief summary of preliminary examination data obtained by optical microscopy. The unique identification number assigned to the particle appears at the top of the page. Sources of the descriptive data are as follows:

SIZE (μm) is measured using the original SEM image and its known magnification factor. For an irregularly shaped particle, the minimum dimension in the plane of the field of view is located and determined; then a second (maximum) dimension is measured at a right angle to the first. For a spherical or equidimensional particle, only a single size is recorded.

SHAPE is generalized to be spherical (S), equidimensional (E), or irregular (I). Particles having shape intermediate between S and E, or E and I, are not uncommon and may be denoted as S/E or E/I, etc.

TRANSPARENCY (abbreviated TRANS.) is determined by optical microscopy to be transparent (T), translucent (TL), or opaque (O). Significant variations in transparency within a particle are annotated on the SEM image.

COLOR is determined by optical microscopy using oblique (fiber-optic, quartz-halogen) illumination supplemented with normal reflected (tungsten-lamp) illumination. The distinction of dark (Dk.) from light (Lt.) particles is unambiguous, although the distinction of colorless (CL) from pale-colored conditions is sometimes problematical. Complex colorations of individual particles may be noted in the "COMMENTS" column and annotated on the SEM image.

LUSTER is determined by optical microscopy using reflected normal (tungsten-lamp) illumination and supplemented with oblique (fiber-optic, quartz-halogen) illumination. Commonly applied descriptions, adopted from

mineralogical usage, include dull (D), metallic (M), submetallic (SM), subvitreous (SV), and vitreous (V). Lusters transitional between categories or difficult to identify are indicated accordingly (D/SM, SV/V, etc.).

TYPE indicates a provisional first-order identification of each particle based on its morphology (from SEM image), elemental composition (from EDS spectrum), and optical properties. We emphasize that, for catalog purposes, types are defined for their descriptive and curatorial utility, not as scientific classifications. These tentative categorizations, which reflect judgements based on the collective experience of the CDPET, should not be construed to be firm identifications and should not dissuade any investigator from requesting any given particle for detailed study and more complete identification. In the absence of any generally accepted taxonomy for stratospheric dust, the precise identification of each particle in our inventory is beyond the scope and intent of our collection and curation program. Indeed, the reliable identification and scientific classification of cosmic dust is one of many important research tasks that we hope this catalog will stimulate. We indicate particle "TYPE" only to aid the users of this catalog (especially those new to small-particle analysis) in distinguishing possible cosmic dust particles from other particles which are invariably collected during stratospheric dust sampling. In this catalog, particles are organized according to their type. Categories used in this catalog are defined as follows:

AOS: Aluminum oxide sphere. An AOS is transparent, subvitreous to vitreous in luster, colorless to pale yellow and at least approximately spherical. However, shape may range from nearly perfect sphericity to pronounced ellipticity and surface texture may range from very smooth to rough. Other spheres or

irregularly shaped material may be attached to its surface. Al is the distinctively dominant (or only) peak in its EDS spectrum. A sphere displaying the attributes of an AOS except with major elements in addition to Al may be listed as "AOS?" or "?". Transparent Al-rich particles of irregular shape would probably be listed as "TCA?". (AOS particles are products of solid-fuel rocket exhausts.)

C: Cosmic dust (variety unspecified) or other extraterrestrial material. In the strict sense, "cosmic dust" refers only to those particles which have not been modified during passage from interplanetary space to Earth's stratosphere. In this catalog, though, particle type "C" is used to conveniently group together all particles which are judged to be of extraterrestrial origin, including those that have apparently experienced strong ablatational heating or melting. Type "C" particles are provisionally identified as those having one of the three following sets of attributes:

(a) irregular to spherical, opaque, dark-colored particles composed mostly of Fe with minor Ni or S.

(b) irregular to spherical, translucent to opaque, dark-colored particles containing various proportions of Mg, Si, and Fe with traces of Al, Ca, S, or Ni.

(c) irregular to faceted or blocky, transparent to translucent particles containing mostly Mg, Si, and Fe but with traces of Al or Ca.

Category (a) and (b) particles commonly display either complex, porous aggregate type morphologies or distinctively spherical

shapes and dull to metallic lusters which distinguish them from terrestrial minerals. Their EDS spectra are reminiscent of those exhibited by meteoritic Fe-Ni or FeS minerals, or combinations of Fe-Ni-S phases with olivine and/or pyroxene. Category (c) particles display morphologies and EDS spectra which suggest that they are fragments of olivine or pyroxene crystals, neither of which are significant components of stratospheric volcanic ash. Particles which do not fall easily into categories (a), (b), or (c) but which possess some of the same attributes may be classified here as "C?".

TCA: Terrestrial contamination (artificial or man-made). Particles included in the "TCA" category are commonly irregular in shape (though a few may be spherical) and may be transparent, translucent, or opaque. Their EDS spectra commonly show Al, Fe, or Si as the principal peaks but with a variety of minor peaks including those of Ti, V, Cr, Mn, Ni, Cu, or Zn and at abundances which are frequently much greater than those expected in common minerals. However, such compositions are similar to those expected for certain metal alloys. In some cases, a high intensity (relative to intensities of characteristic X-ray peaks) of continuum radiation occurs in the EDS spectrum, suggesting that low atomic number elements not detectable by the EDS (e.g., H, C, N, O) are abundant in the particle. Such "TCA" particles are tacitly inferred to be synthetic carbon-based materials. (This category probably includes particles produced by or derived from aircraft operation or collector hardware, or possibly spacecraft debris.

However, some of these particles are worthy of additional research and may represent true extraterrestrial "low Z" material).

- TCN: Terrestrial contamination (natural). "TCN" particles may be transparent to opaque and may exhibit a variety of colors. However, they are commonly irregular in shape and distinctively rich in Si and Al with minor abundances of Na, K, Ca, or Fe. Morphologies and EDS spectra of most "TCN" particles compare favorably with respective properties of silica polymorphs, feldspar, or silicic volcanic glass, three materials which are principal components of stratospheric volcanic ash. In addition, platy or porous aggregate-type particles of light color and Si, Al-rich composition may be silicic clay minerals, common phases in Earth's surface soils. Irregular, reddish Fe rich particles may also be products of terrestrial rock weathering. Recognition of these and other phases as "TCN" particles is based mostly on CDPET's collective mineralogical experience and comparison with reference samples. Less commonly, the "TCN" category may include distinctive particles with apparently non-random shapes which are rich in low atomic number elements (as inferred from their EDS spectra having high levels of continuum X-radiation and relatively small peaks for characteristic X-rays). Those rare particles are distinguished from "TCA" particles by their unusual, organized morphologies and probably represent biological contaminants.
- ?: Identification uncertain. This category includes particles

which do not unequivocally resemble those grouped together as AOS, C, TCA, or TCN. In addition, the "?" symbol is liberally used to reiterate the tentative identifications of other types of particles.

Again, this system for provisional classification of particles is presented only as a first-order attempt to distinguish particles which are probably extraterrestrial in origin from those which are probably contaminants. Many particles, especially those cataloged as type "?", will require careful research examination before they can be satisfactorily identified.

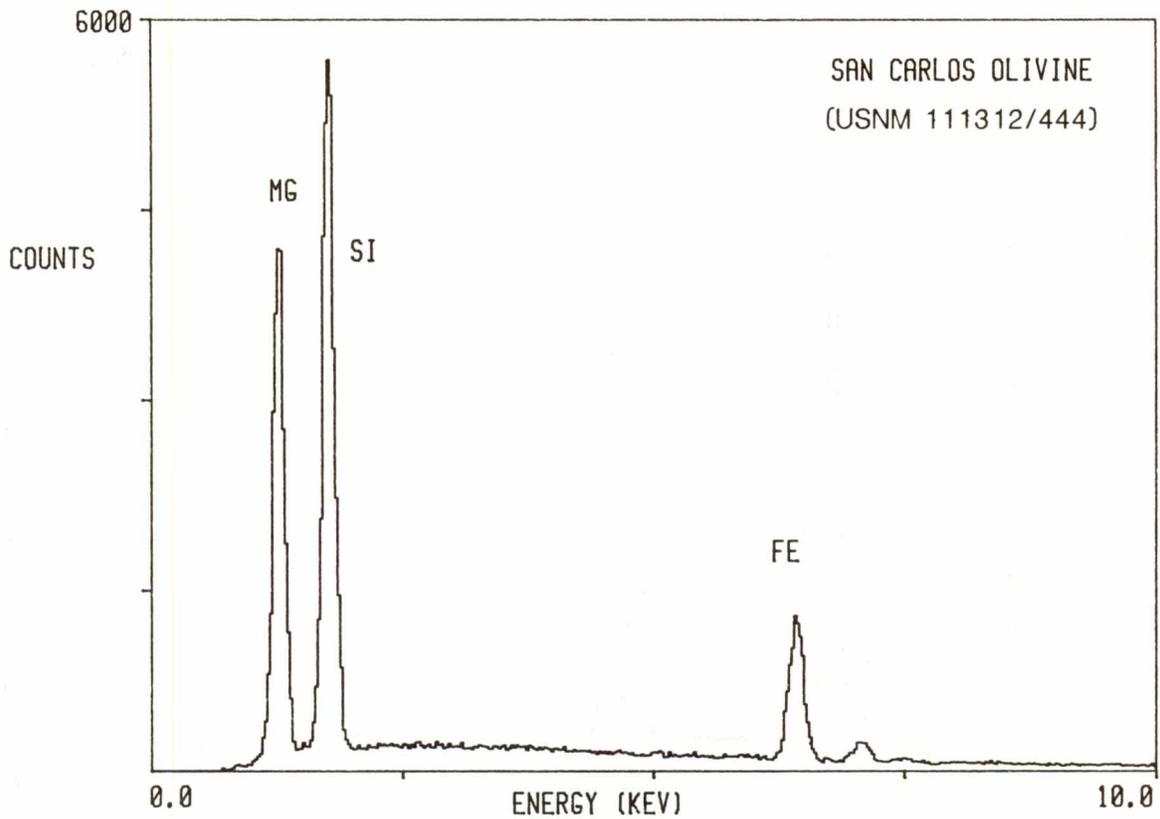
COMMENTS are included for particles with special features or histories. Particles lost during or after preliminary SEM examination, or particles with possible genetic relationships to other particles are noted here.

5. ANALYSES OF REFERENCE MATERIALS

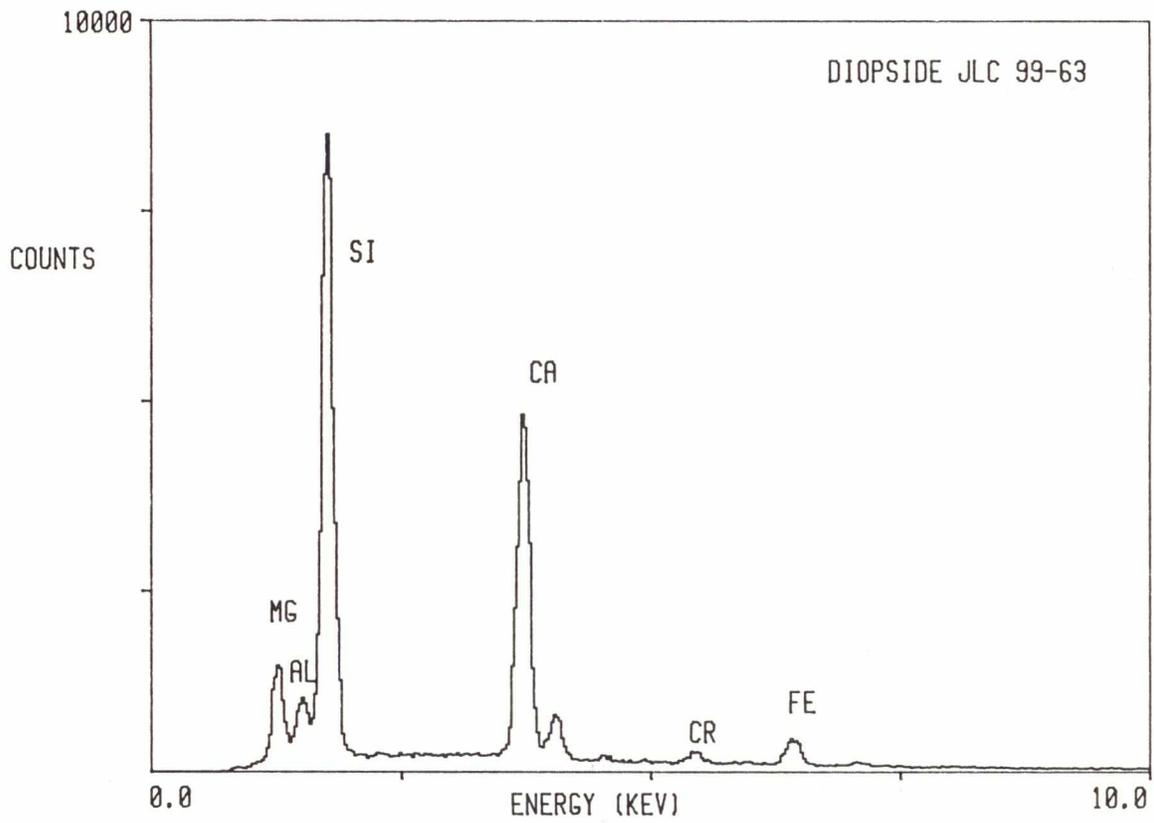
The usefulness of the SEM images and EDS spectra provided for particles in this catalog is enhanced by comparison with similar data products obtained for mineral standards of known composition. Accordingly, a typical EDS spectrum is presented for each of three standard minerals prepared as polished grain mounts (San Carlos olivine, USNM 111312/444; diopside JLC-99-63; Kakanui hornblende, USNM 143965). Analyses of these optically flat surfaces eliminate inter-sample geometrical variations so that effects of detection limits and compositional variations, in general, on relative peak heights in the raw spectra can be more readily assessed. Even so, the polished grain spectra should not be over interpreted because no corrections have been attempted for atomic number, absorption, or fluorescence effects. The spectra are presented simply as additional aids to the meaningful use of the sample particle EDS spectra. Investigators who might wish to compare performance characteristics of their EDS analytical systems with those of the system used by CDPET in preparing these catalog data should contact Curator/Cosmic Dust at the address given in Section 6. A short term loan of a polished grain mineral standard can then be arranged.

As pointed out in Section 3, the EDS spectra included in this catalog were obtained using a primary electron energy of 20 kV whereas spectra in Catalogs 1, 2, and 3 were obtained with a different instrument operated at 40 kV. Although the effects on EDS spectra to be expected from such a change are well known from X-ray spectrometric analysis, they are worth pointing out to avoid confusion among the readers of this catalog. The major effects of concern to Cosmic Dust Catalog users can be seen by comparing the two "Allende (C3) Meteorite Bulk Powder" spectra, one of which was obtained at 20 kV and the other at 40 kV, as presented in Cosmic Dust Catalogs 4 or 5

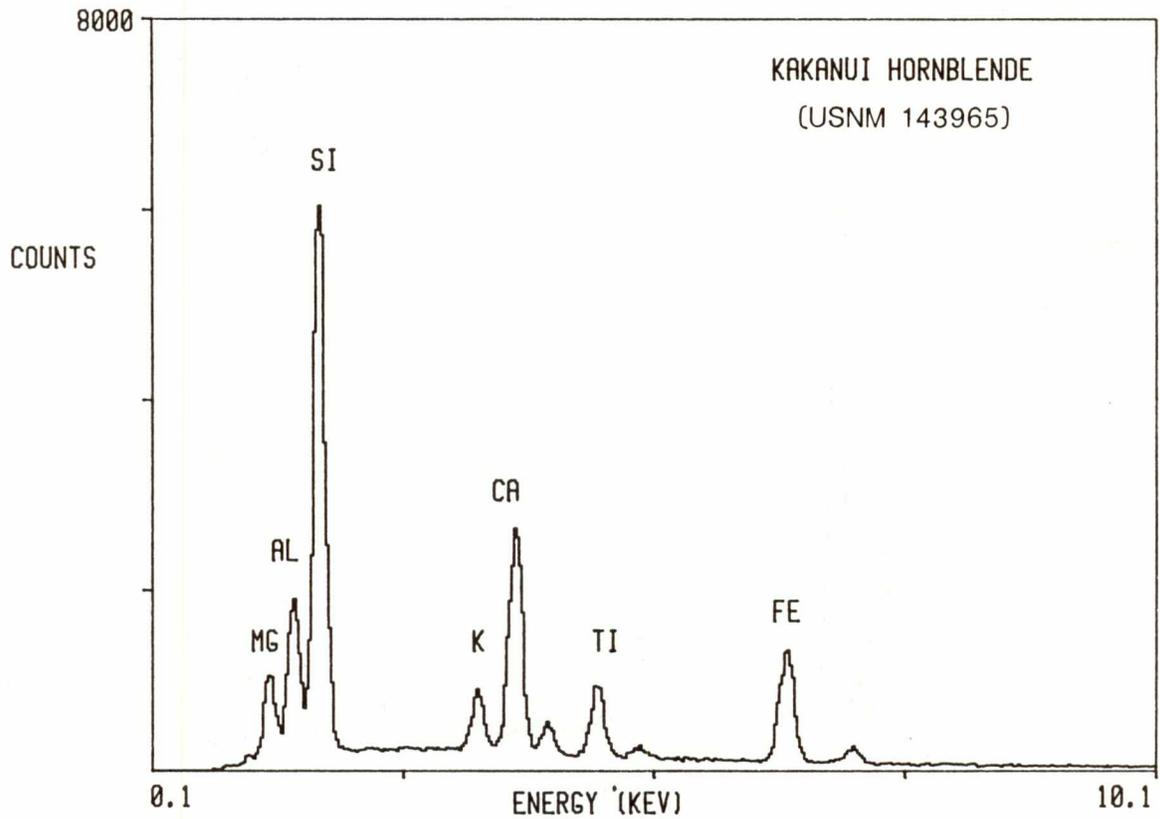
(only spectra collected at 20kV are presented in this catalog). In the 20 kV spectrum, the Si peak is more intense than the principal peak of Fe whereas the opposite is true for the 40 kV spectrum. In general, the 20 kV spectra in this catalog will show peaks of light elements enhanced relative to peaks of heavy elements when compared with 40 kV spectra published in Catalogs 1, 2, and 3. The explanation is based both on geometrical differences between X-ray paths in the two EDS systems (the JEOL-35CF system is actually more favorable for light element analysis) and on electron and X-ray physics (X-ray emission by heavy elements is more intense at 40 kV than at 20 kV). Thus, readers are cautioned against attempting to quantitatively intercompare 20 kV spectra in this catalog with 40 kV spectra in previous catalogs. Still, the spectra in each catalog should continue to serve as originally intended. Namely, the sample and standard spectra in any given catalog will represent a self-consistent data set.



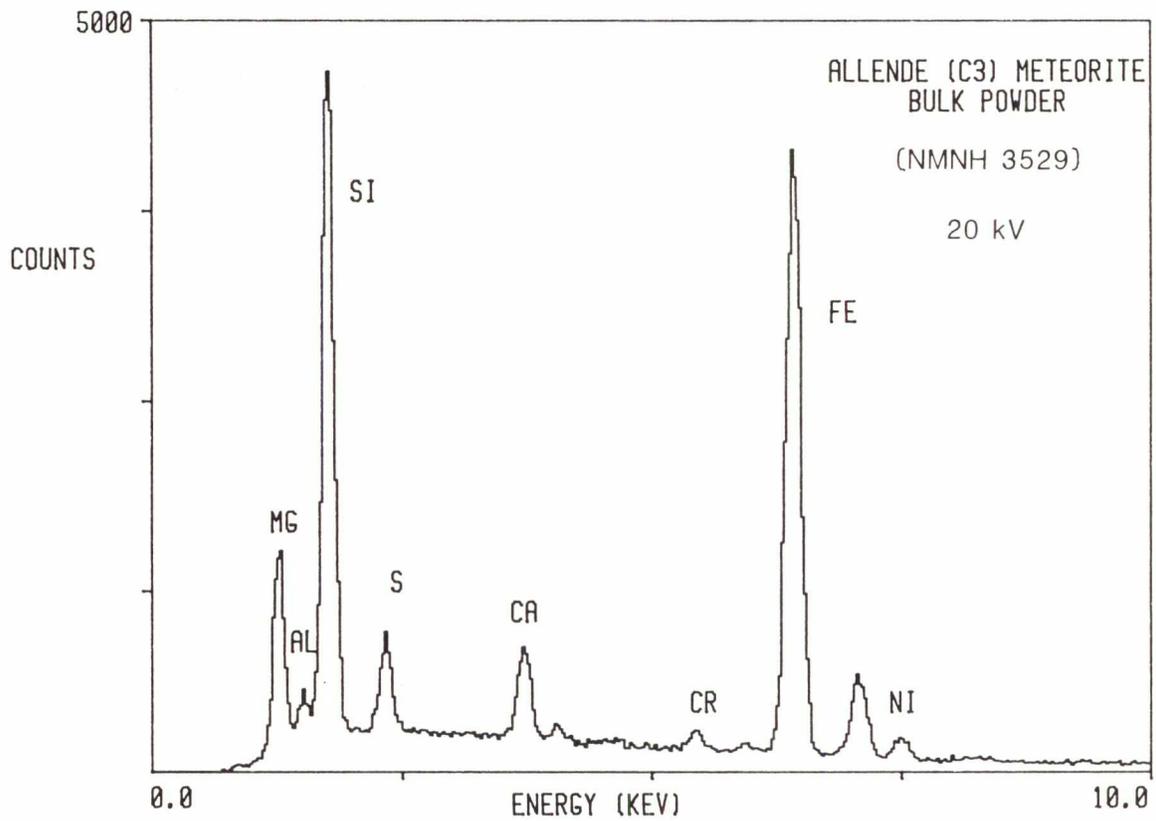
WEIGHT %													TOTAL
SiO ₂	TiO ₂	Al ₂ O ₃	Cr ₂ O ₃	Fe ₂ O ₃	FeO	NiO	MnO	MgO	CaO	Na ₂ O	K ₂ O	H ₂ O	
40.81	-	-	-	-	9.55	0.37	0.14	49.42	<0.05	-	-	-	100.29



WEIGHT %													TOTAL
SiO ₂	TiO ₂	Al ₂ O ₃	Cr ₂ O ₃	Fe ₂ O ₃	FeO	NiO	MnO	MgO	CaO	Na ₂ O	K ₂ O	H ₂ O	
51.93	0.46	6.31	9.96	1.80	2.34	0.04	0.07	16.05	19.64	1.39	-	-	99.99



WEIGHT %													
SiO ₂	TiO ₂	Al ₂ O ₃	Cr ₂ O ₃	Fe ₂ O ₃	FeO	NiO	MnO	MgO	CaO	Na ₂ O	K ₂ O	H ₂ O	TOTAL
40.37	4.72	14.90	-	3.30	7.95	-	0.09	12.80	10.30	2.60	2.05	0.94	100.02



WEIGHT %											
SiO ₂	TiO ₂	Al ₂ O ₃	Cr ₂ O ₃	FeO	MnO	MgO	CaO	Na ₂ O	K ₂ O	P ₂ O ₅	C
34.23	0.15	3.27	0.52	27.15	0.18	24.62	2.61	0.45	0.03	0.23	0.29
FeS	NiS	CoS	Fe ⁰	Ni ⁰	Co ⁰	TOTAL					
4.03	1.60	0.08	0.17	0.36	0.01	99.98					

6. SAMPLE REQUESTS

Scientists desiring to perform detailed research on particles described in this catalog should apply in writing to:

Curator/Cosmic Dust	Telephone: (713) 483-6241
Code SN2	or -3274
NASA/Johnson Space Center	FTS: 525-6241
Houston, Texas 77058	or -3274
U.S.A.	

Sample requests should refer to specific particle identification numbers and should describe the research being proposed as well as the qualifications and facilities of the investigator making the request. Additionally, requests for particles not yet passed through preliminary examination will be considered if the requester can demonstrate a strong need for them. NASA will arrange for a review of the scientific merits of each request and will inform the requester of the results. Approval of a sample request does not imply or include funding for the proposed research. Questions about NASA funding should be directed to:

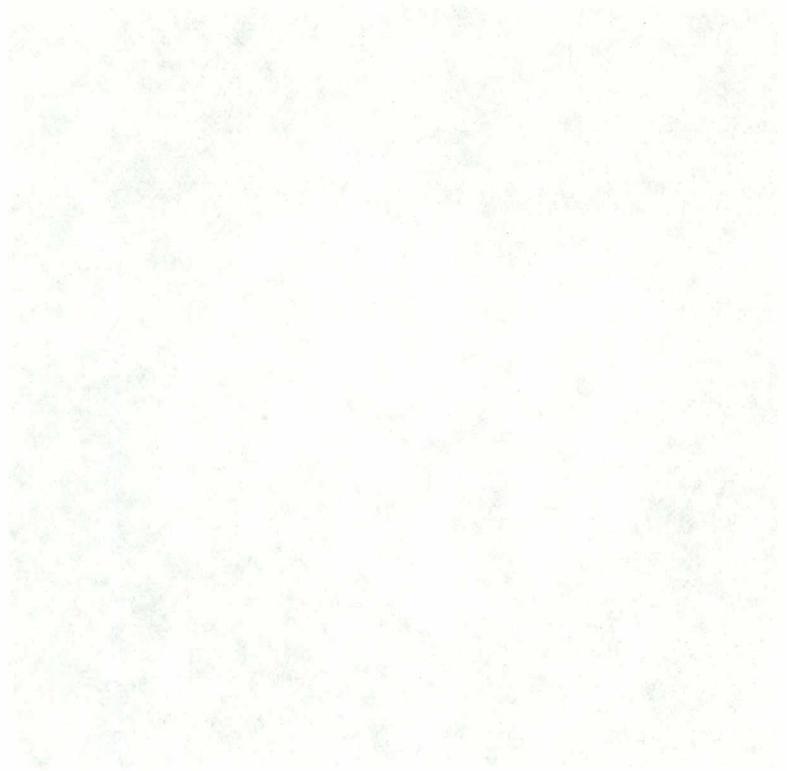
Dr. Donald D. Bogard
Discipline Scientist
Planetary Materials and Geochemistry Program
Code SN-4
NASA/Johnson Space Center
Houston, TX 77058

Although foreign scientists are welcome to request samples, NASA cannot provide funds to be spent outside the U.S.A. by citizens of other countries.

7. ACKNOWLEDGEMENTS

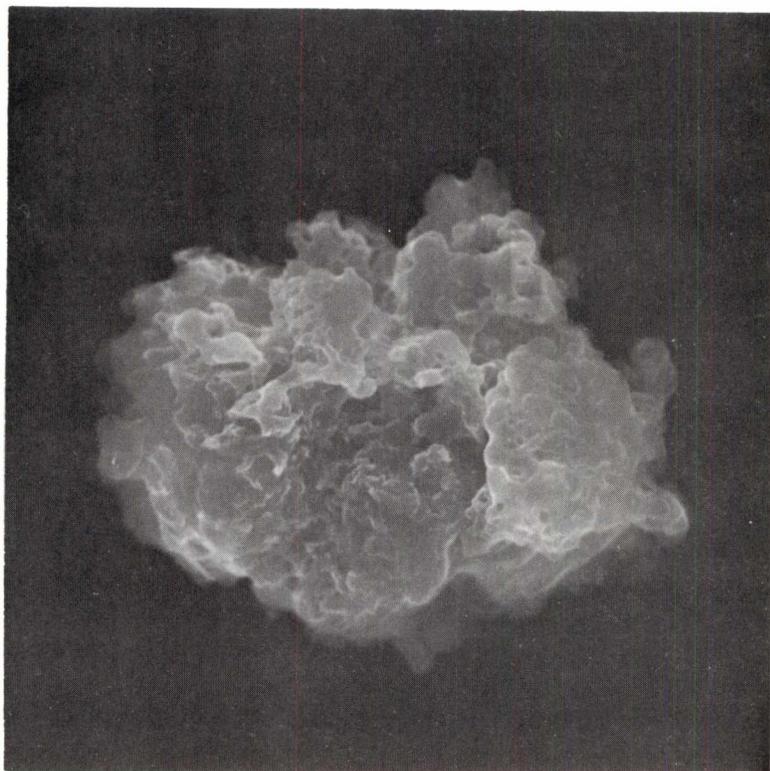
Guy V. Ferry and co-workers (NASA/Ames Research Center, Moffett Field, California) performed the loading and unloading of the cosmic dust collectors on the U-2 aircraft and provided flight log data.

Eugene Jarosewich (Smithsonian Institution, Washington, D.C.) kindly provided mineral standards and the Allende chondrite powder.



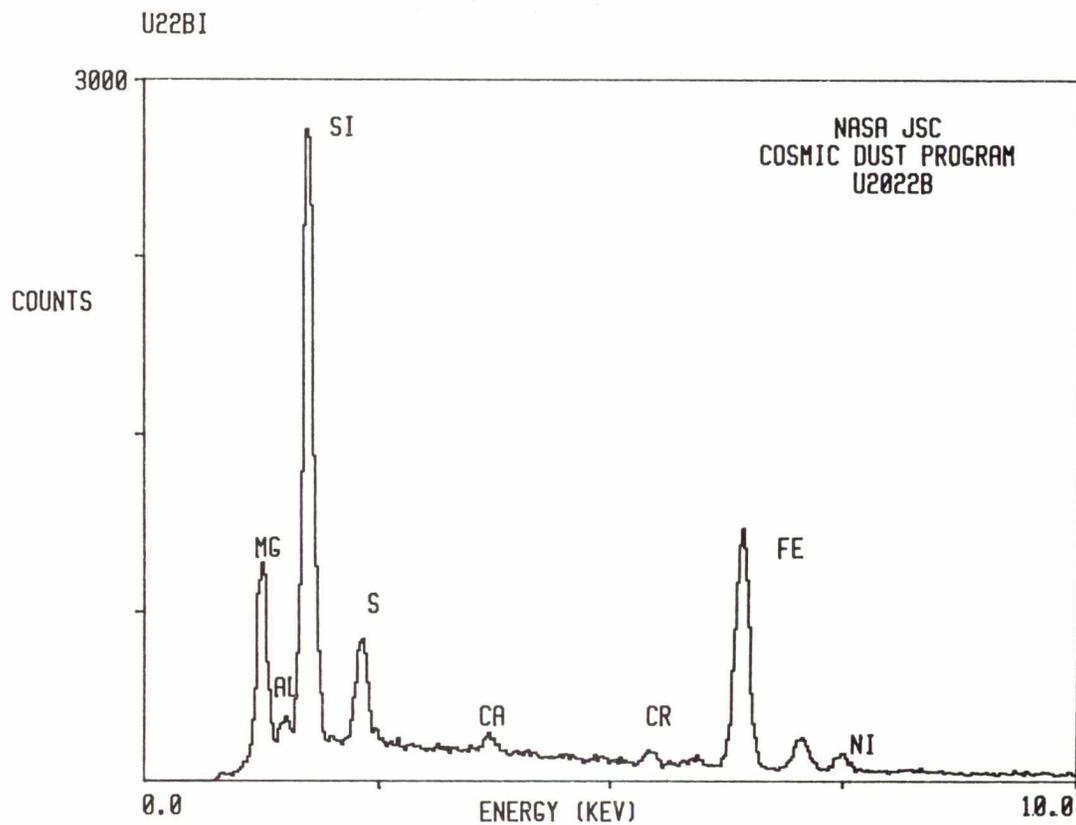
COSMIC DUST

U2022 B 1

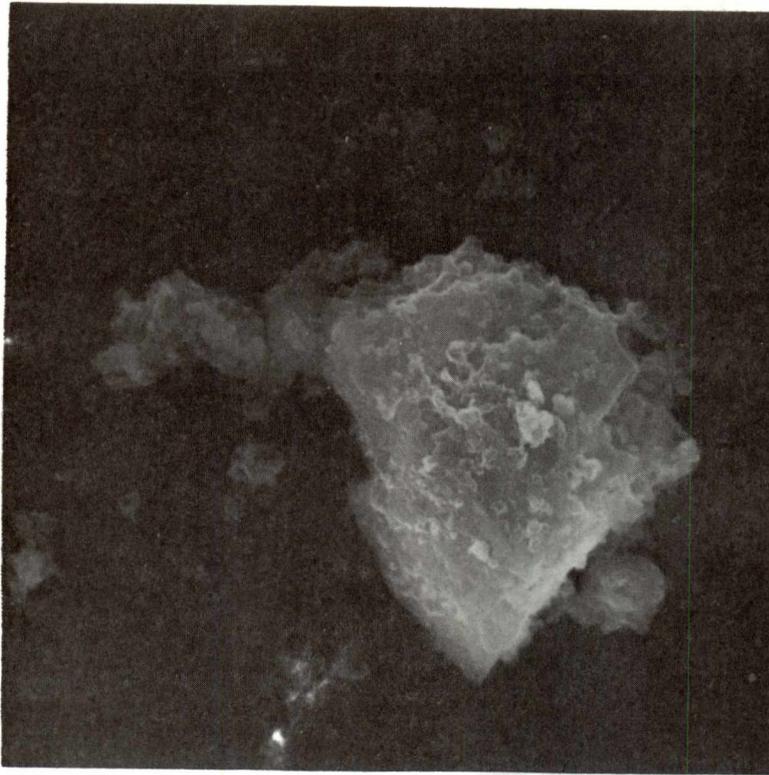


SIZE: 30x20
SHAPE: I
TRANS.: O
COLOR: Brown to Black
LUSTER: SM/D
TYPE: C
COMMENTS:

S-85-42766

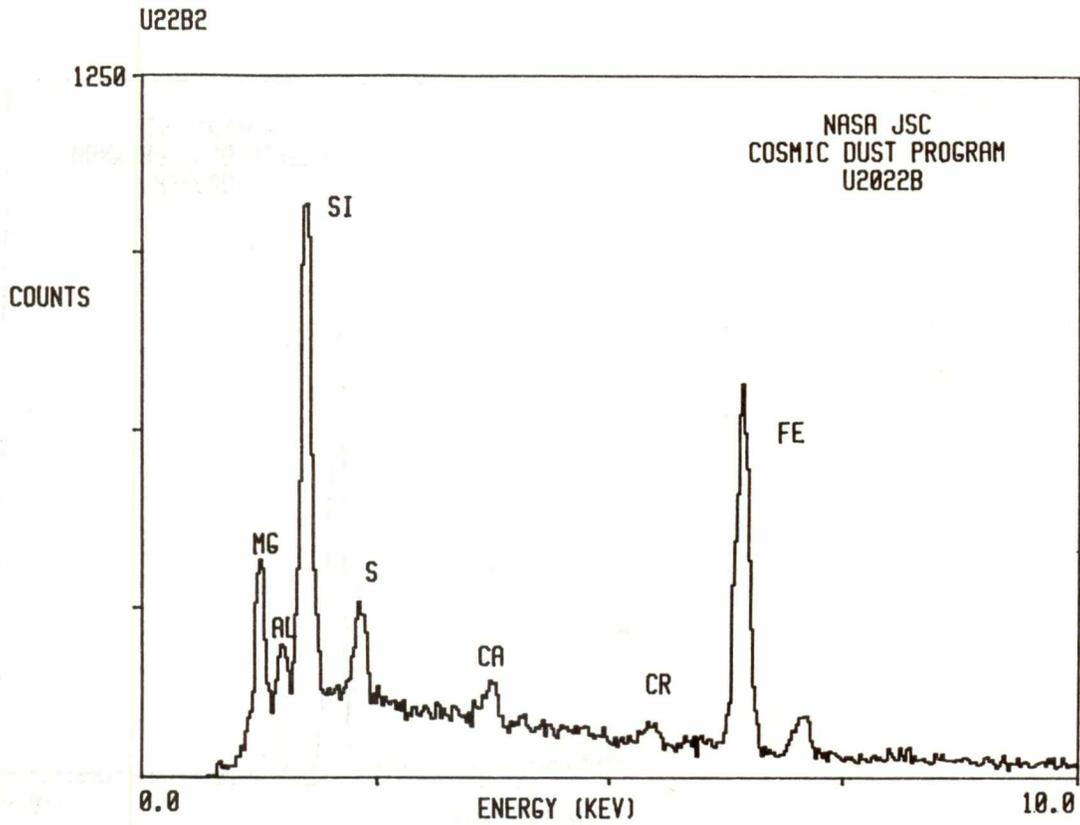


U2022 B 2

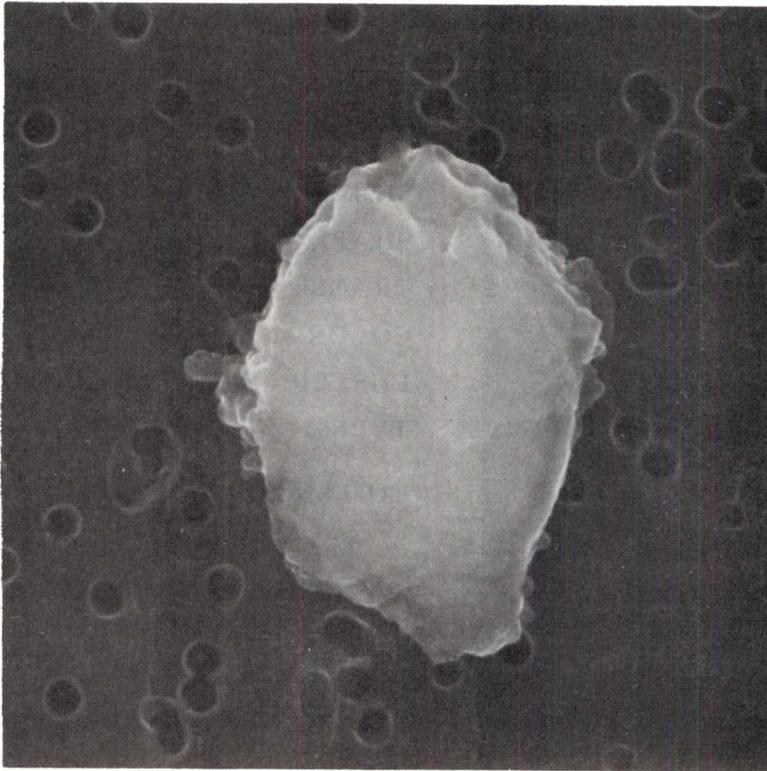


SIZE: 22
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TRANS.: O
COLOR: Brown to Black
LUSTER: SM/D
TYPE: C
COMMENTS:

S-85-42767



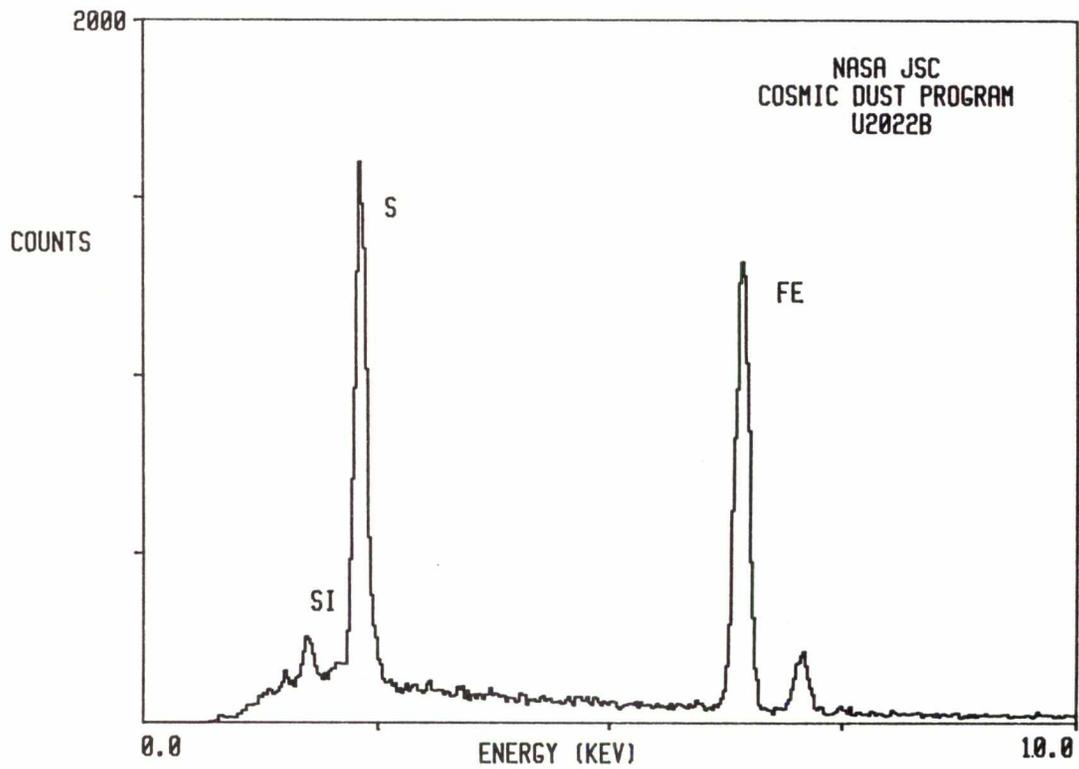
U2022 B 8



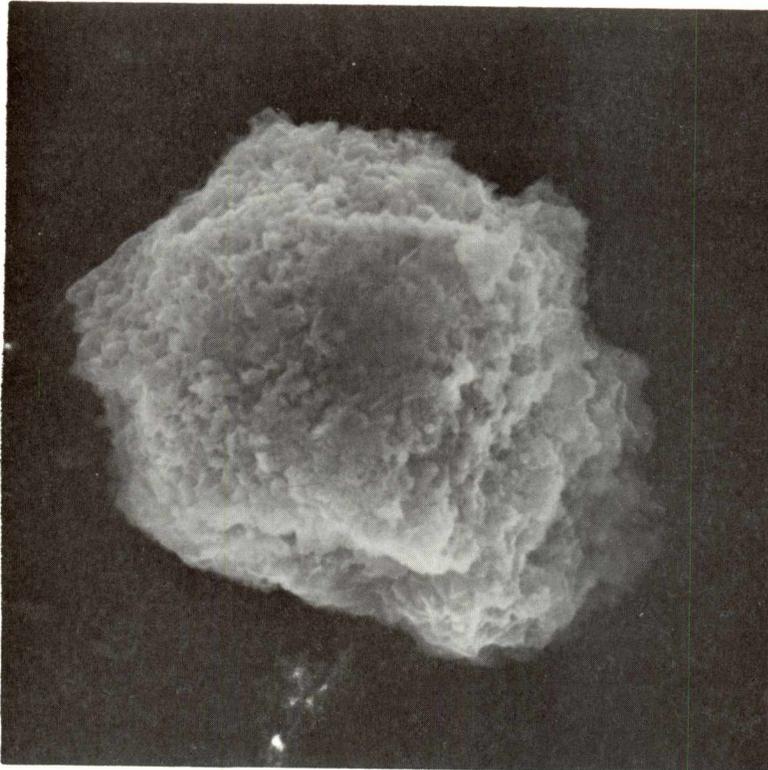
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SHAPE: S
TRANS.: T
COLOR: Colorless
LUSTER: V
TYPE: C
COMMENTS:

S-85-42772

U22B8



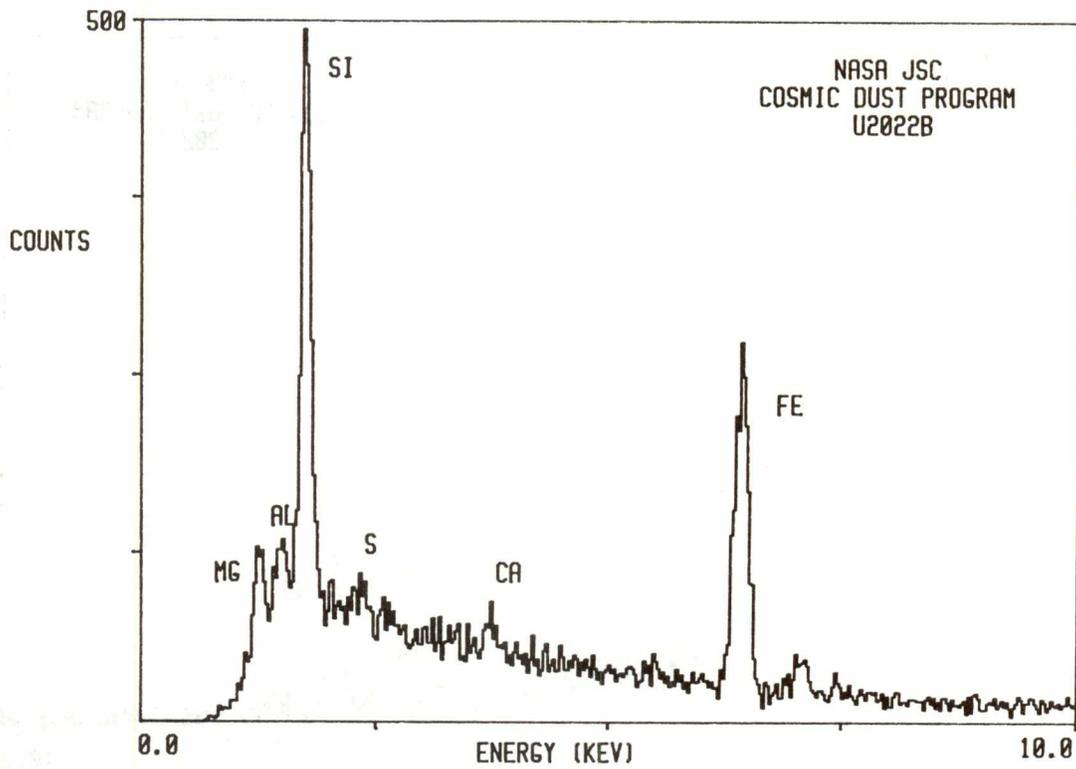
U2022 B 12



SIZE: 40
SHAPE: I
TRANS.: O
COLOR: Gold to Black
LUSTER: SM/D
TYPE: C
COMMENTS:

S-85-42775

U22B12



U2022 C 7



SIZE: 13x10

SHAPE: I

TRANS.: O

COLOR: Black

LUSTER: D

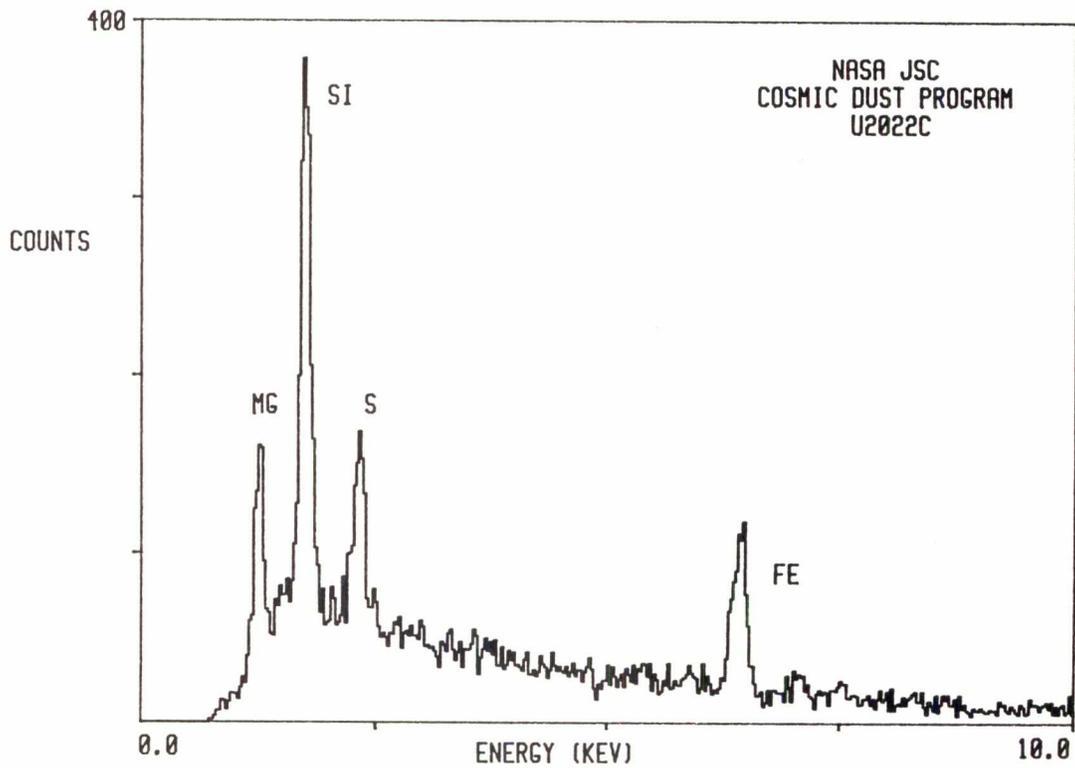
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COMMENTS:

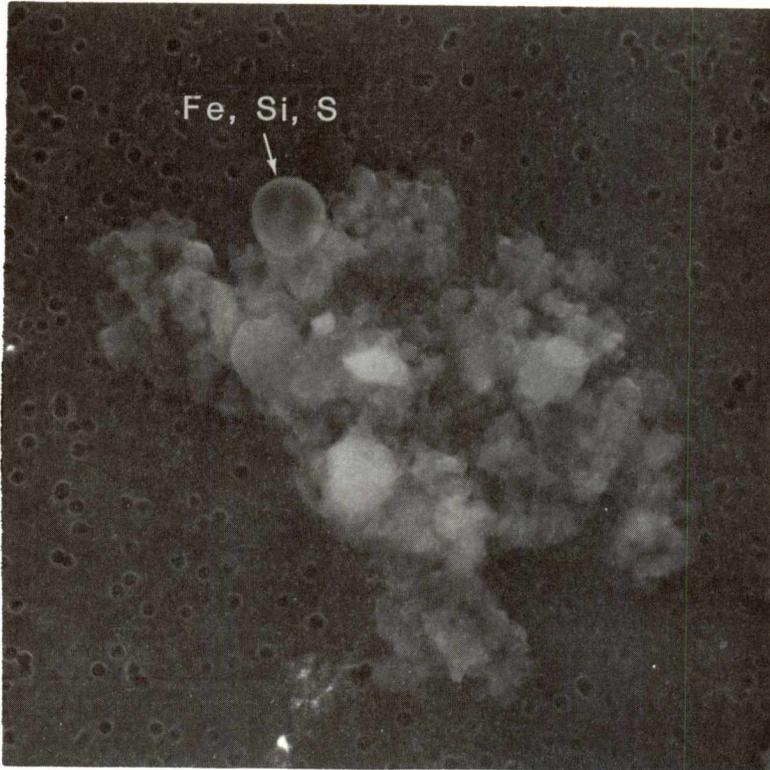
Related to U2022C8
and 9

S-85-42790

U22C7



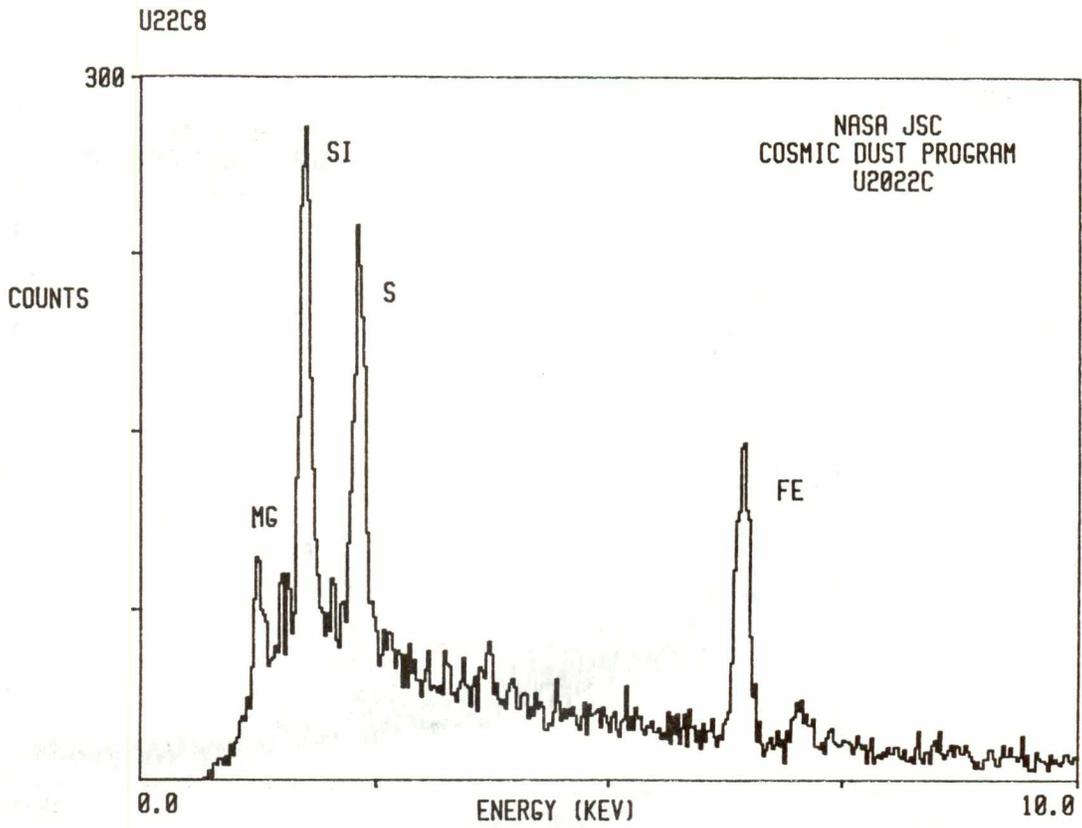
U2022 C 8



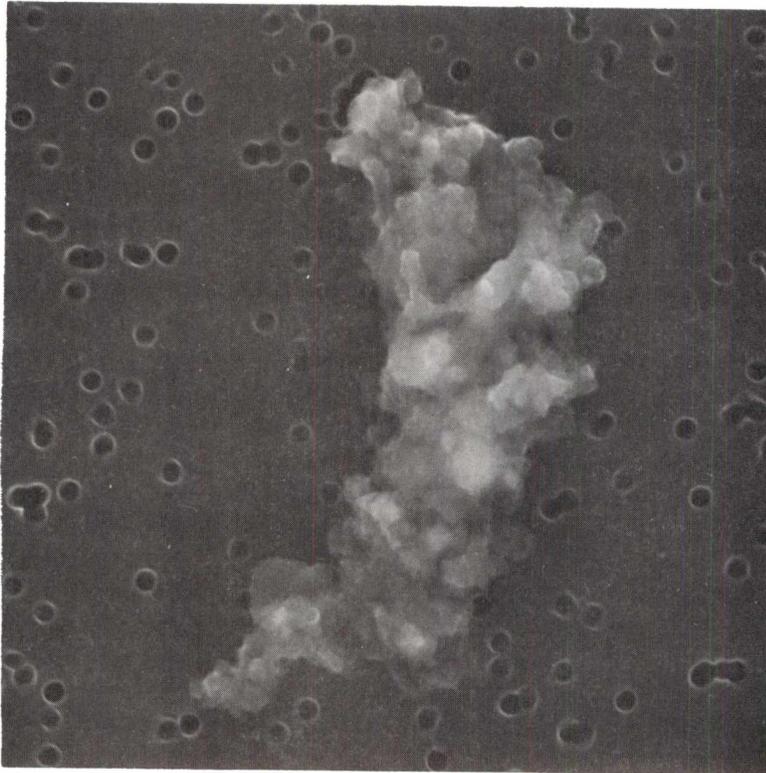
SIZE: 16
SHAPE: I
TRANS.: O
COLOR: Black
LUSTER: D
TYPE: C

COMMENTS:
Related to U2022C7
and 9

S-85-42791



U2022 C 9



SIZE: 11x4

SHAPE: I

TRANS.: O

COLOR: Black

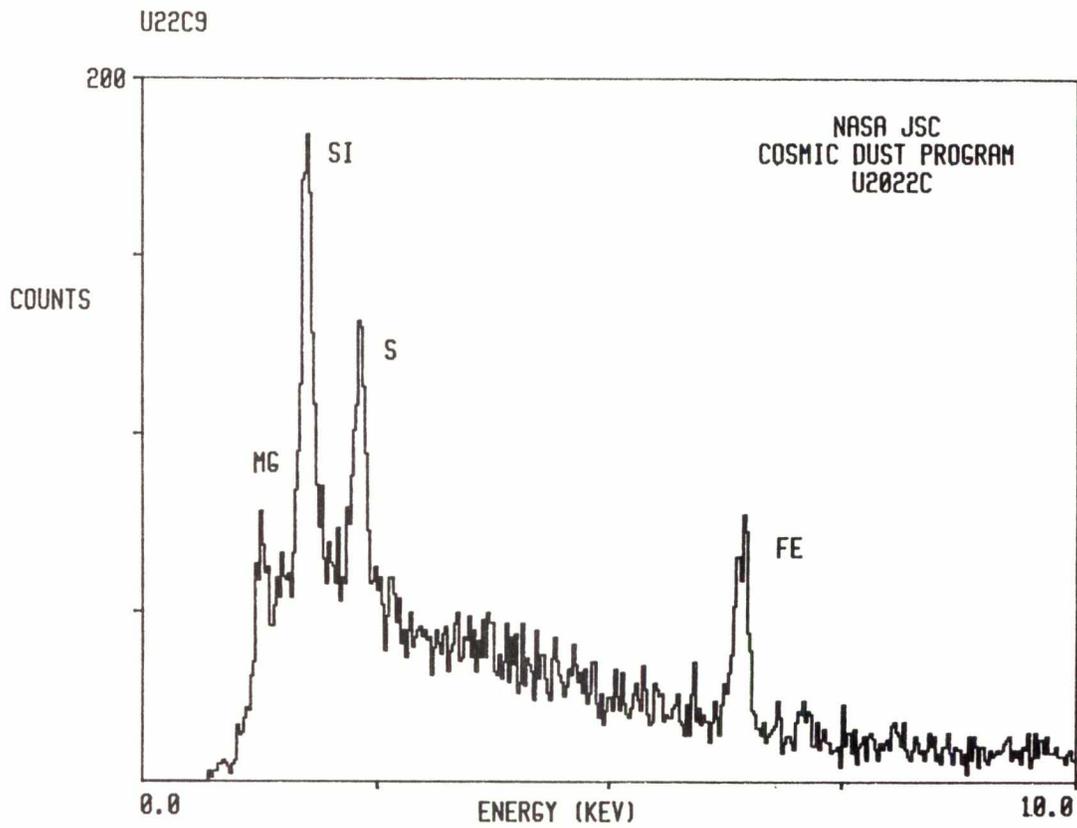
LUSTER: D

TYPE: C

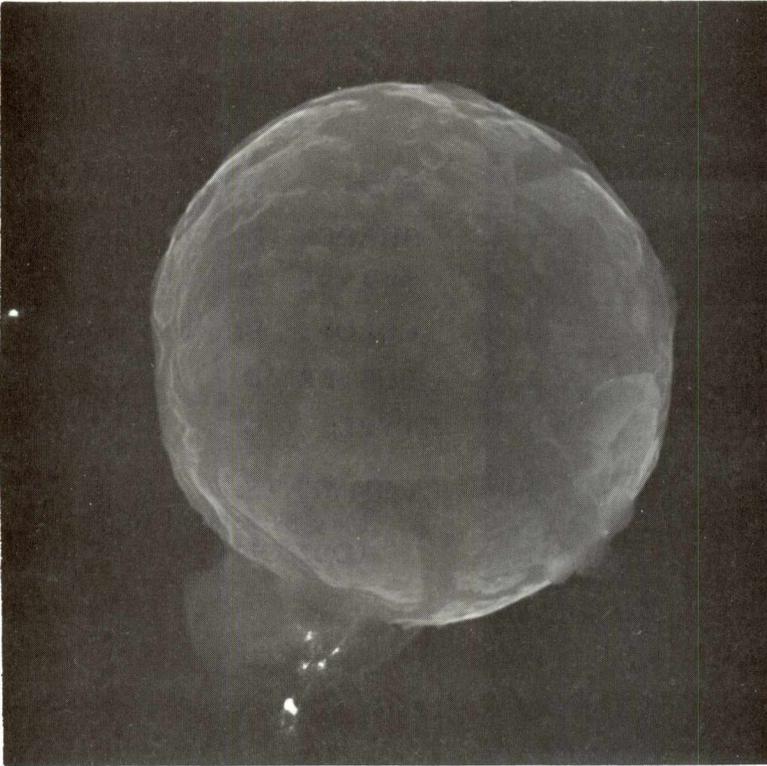
COMMENTS:

Related to U2022C7
and 8

S-85-42792



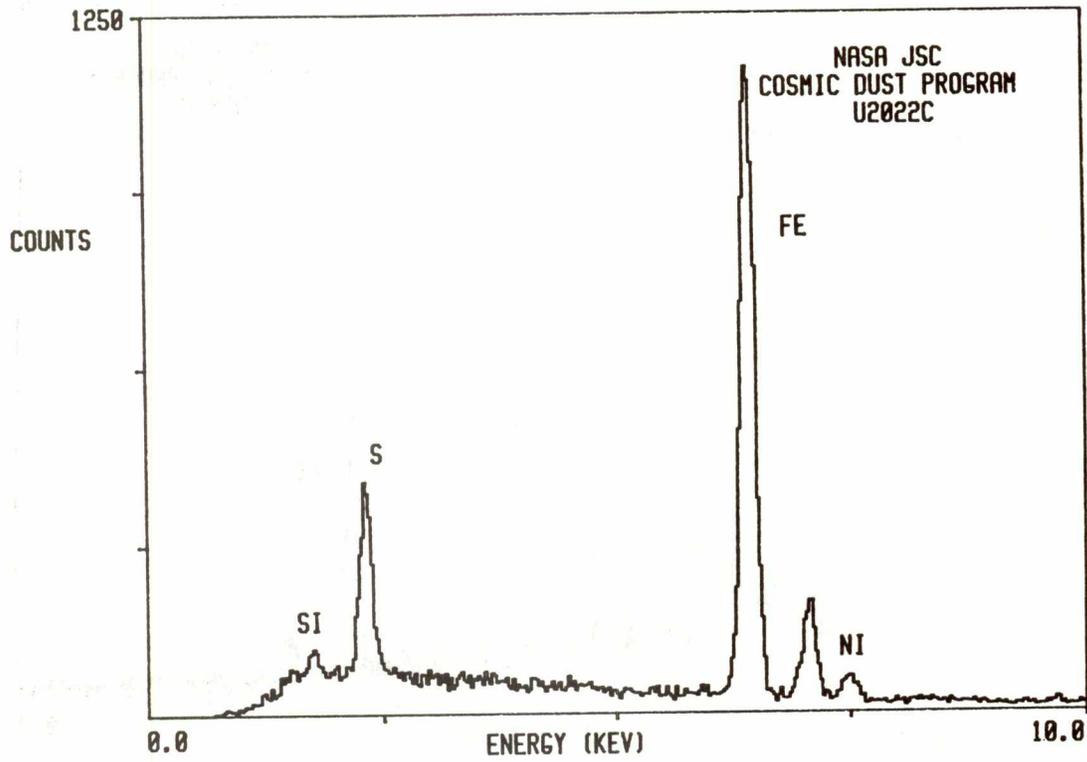
U2022 C 10



SIZE: 13
SHAPE: S
TRANS.: O
COLOR: Black
LUSTER: M
TYPE: C?
COMMENTS:

S-85-42794

U22C10



U2022 C 12

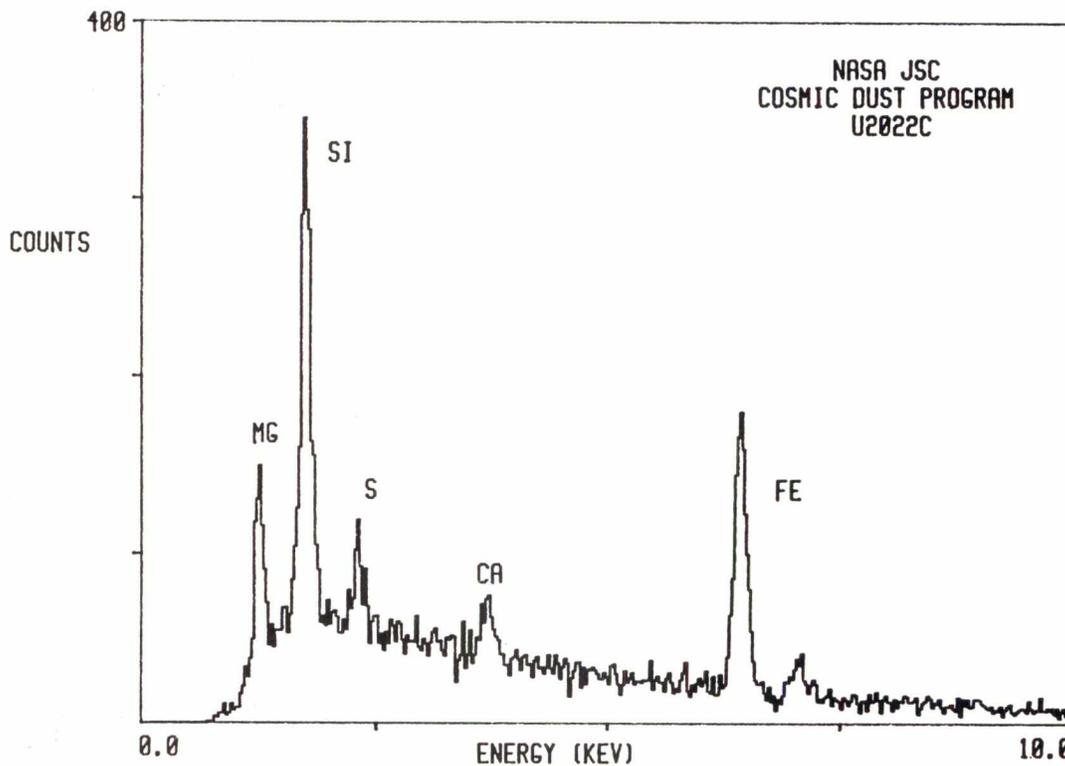


SIZE: 8x12
SHAPE: I
TRANS.: O
COLOR: Brown to Black
LUSTER: D
TYPE: C

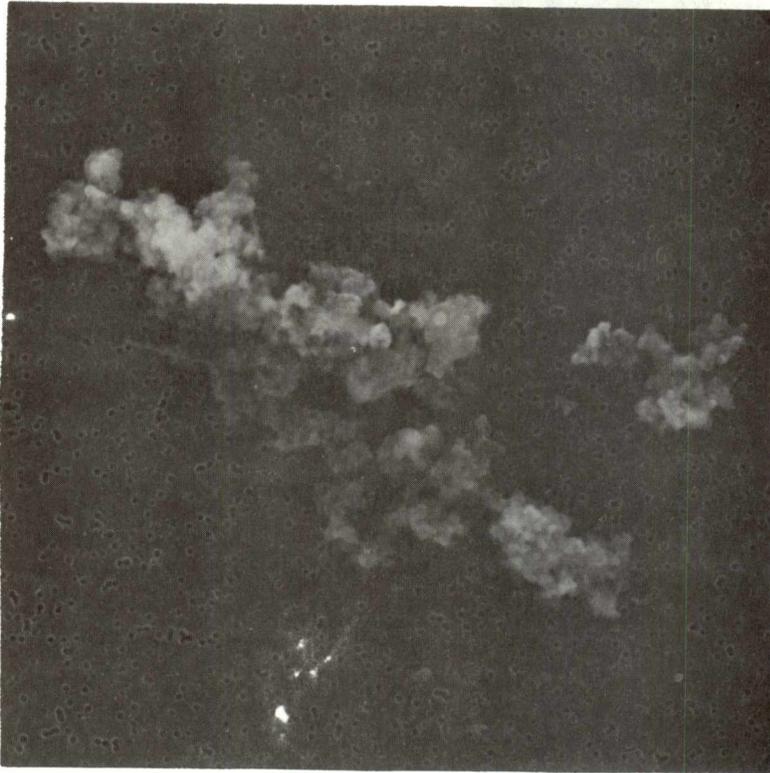
COMMENTS:
May be related to
U2022C11

S-85-42795

U22C12



U2022 C 13



SIZE: 40x12

SHAPE: I

TRANS.: O

COLOR: Black

LUSTER: D

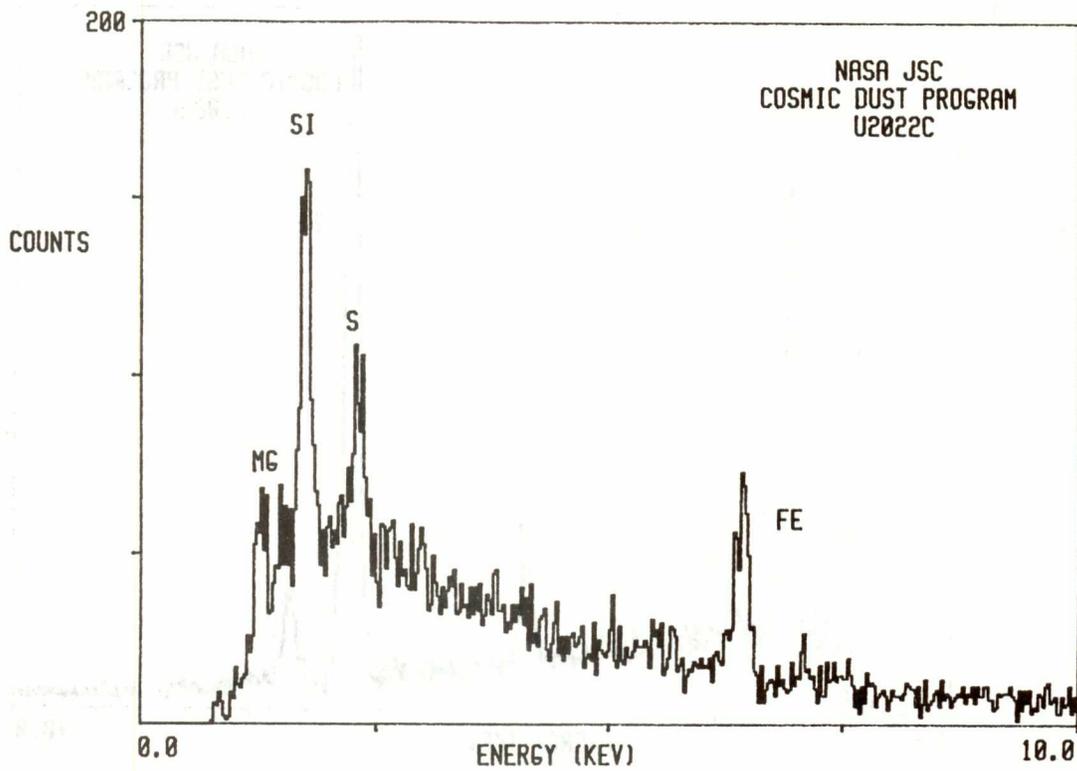
TYPE: C

COMMENTS:

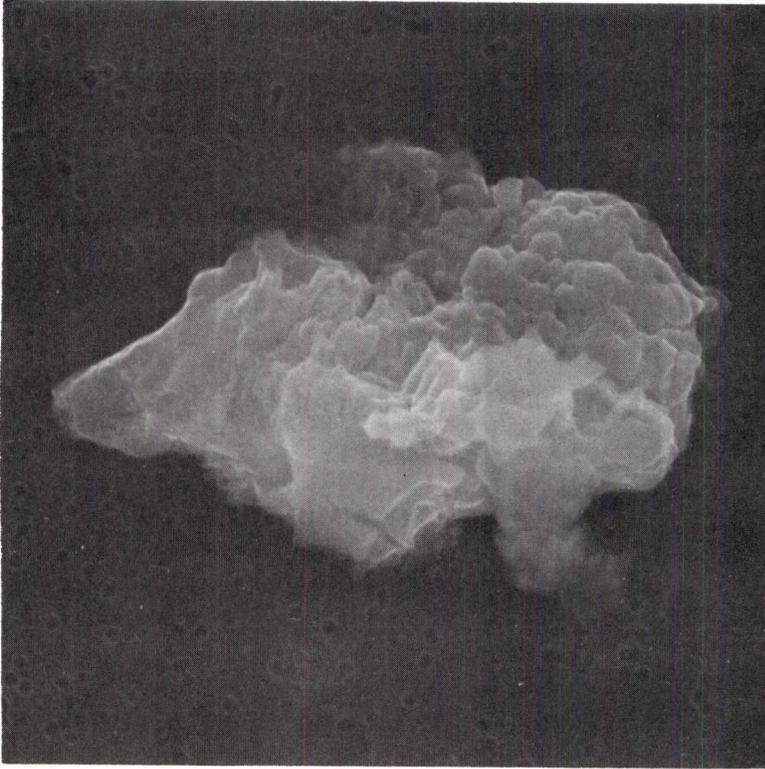
Largest of several grains

S-85-42796

U22C13

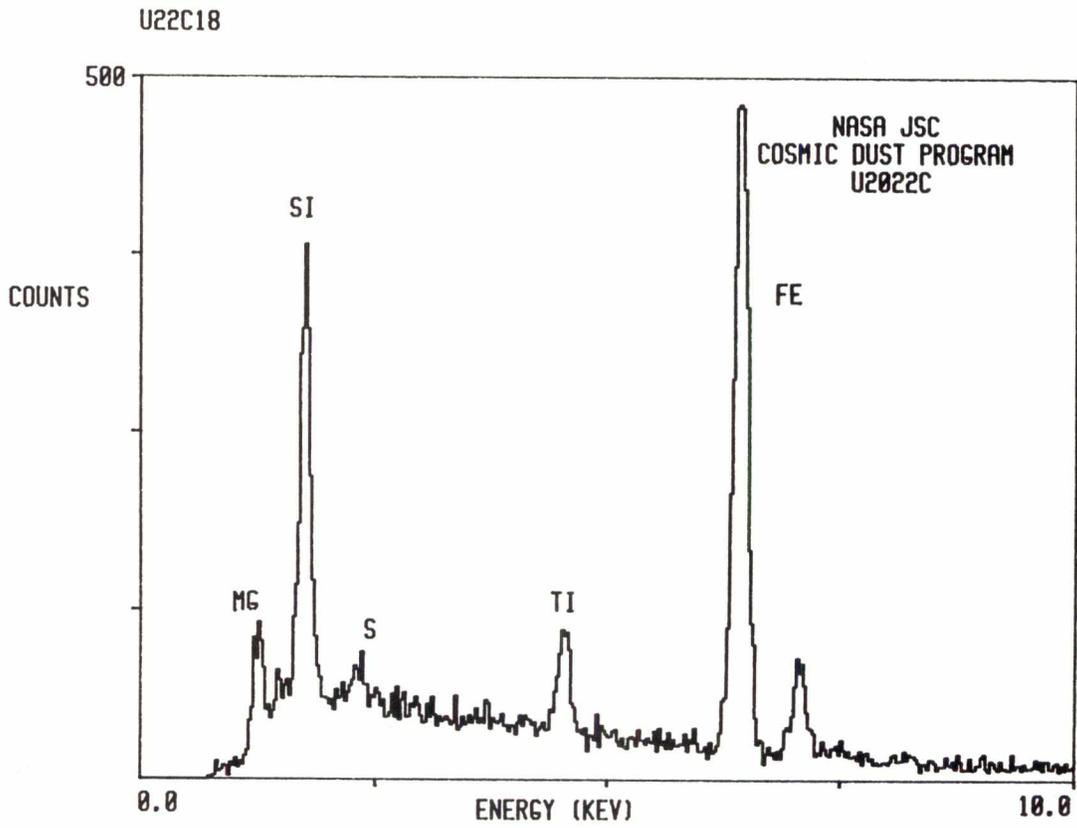


U2022 C 18

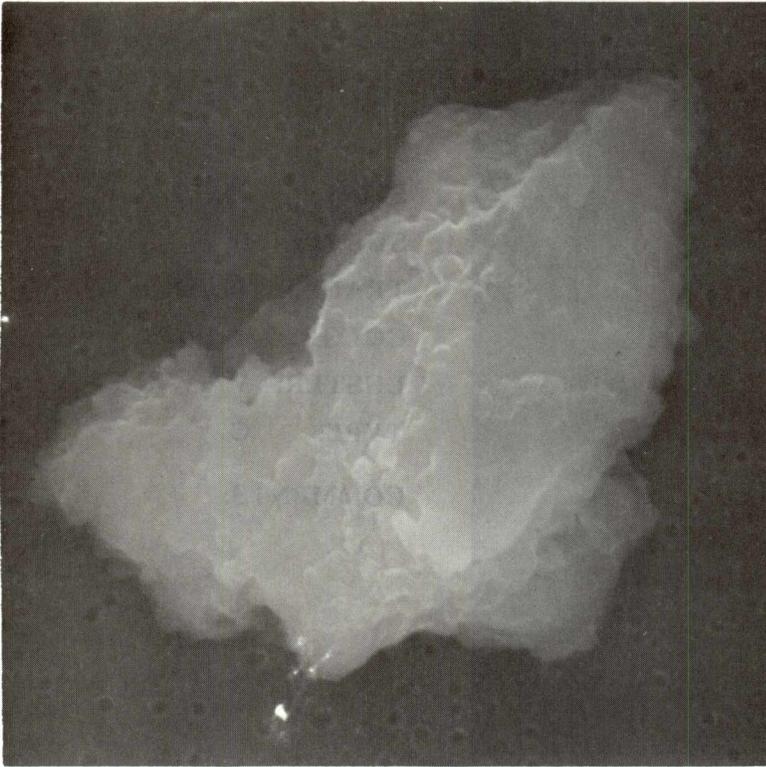


SIZE: 16x10
SHAPE: I
TRANS.: O
COLOR: White to Black
LUSTER: SV/D
TYPE: C
COMMENTS:

S-85-42801



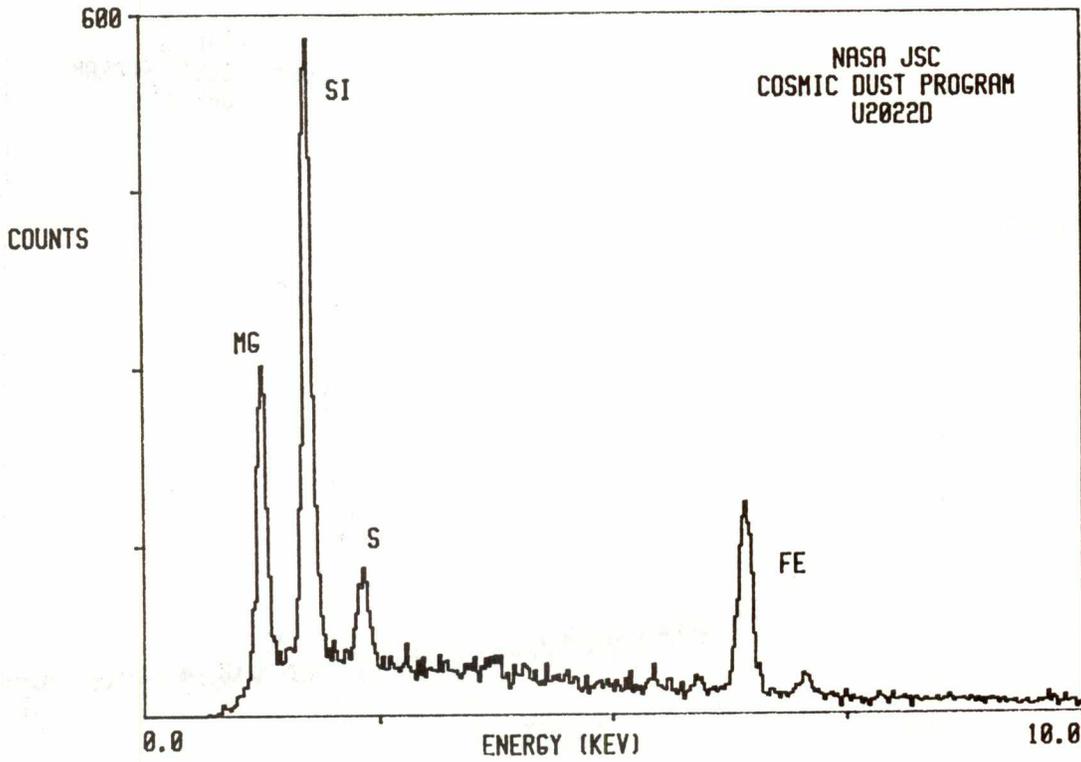
U2022 D 11



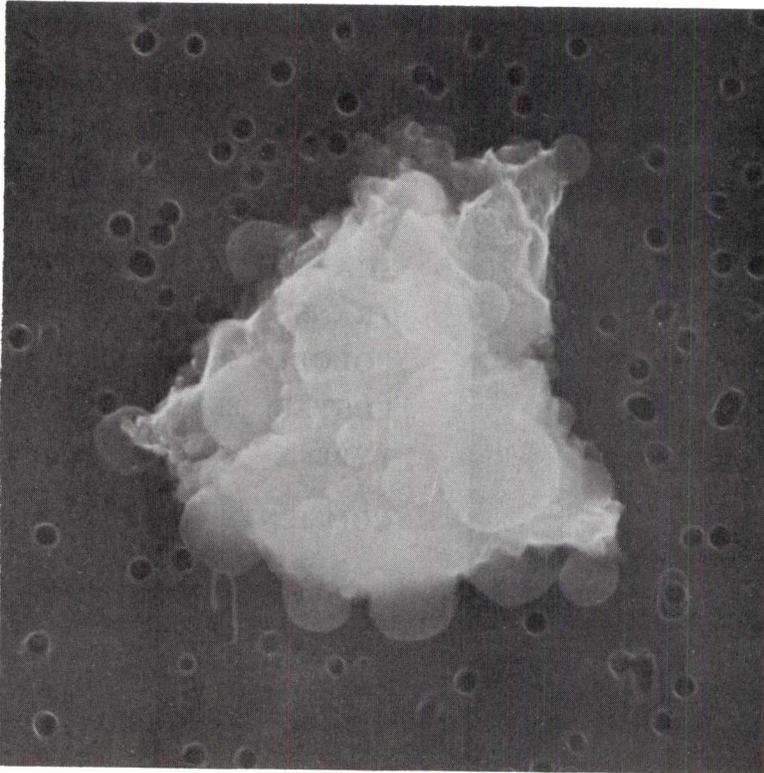
SIZE: 15x10
SHAPE: I
TRANS.: O
COLOR: Gold to Black
LUSTER: SM/D
TYPE: C
COMMENTS:

S-85-42809

U22D11



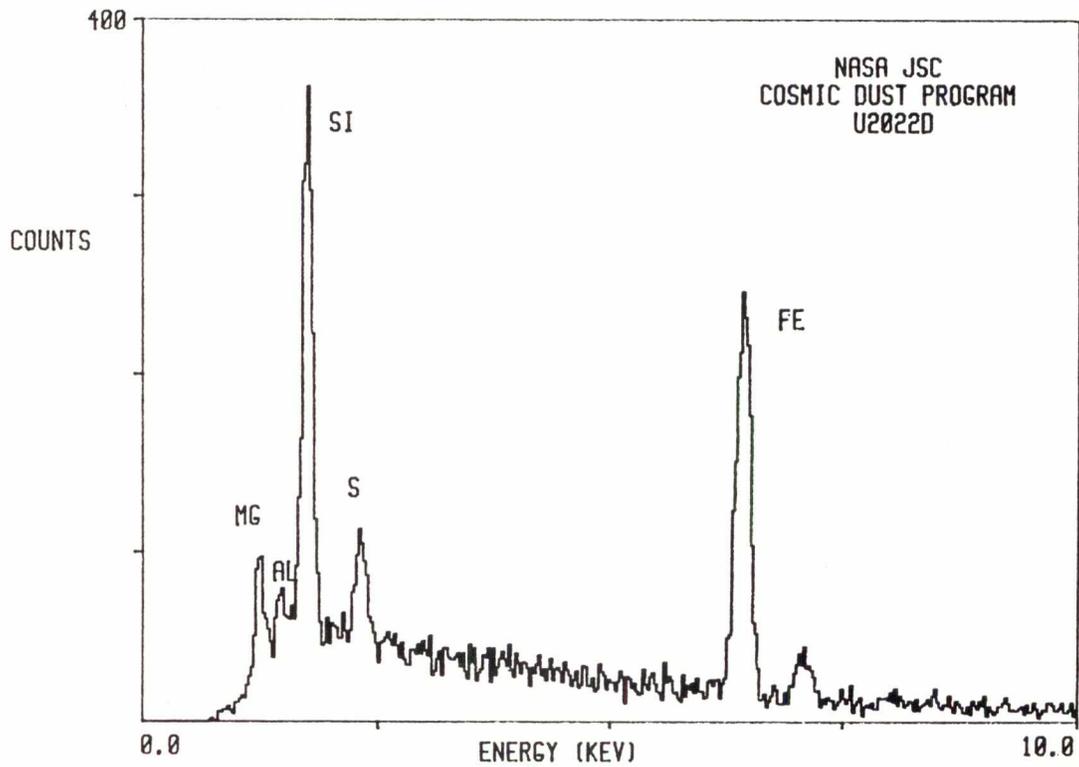
U2022 D 14



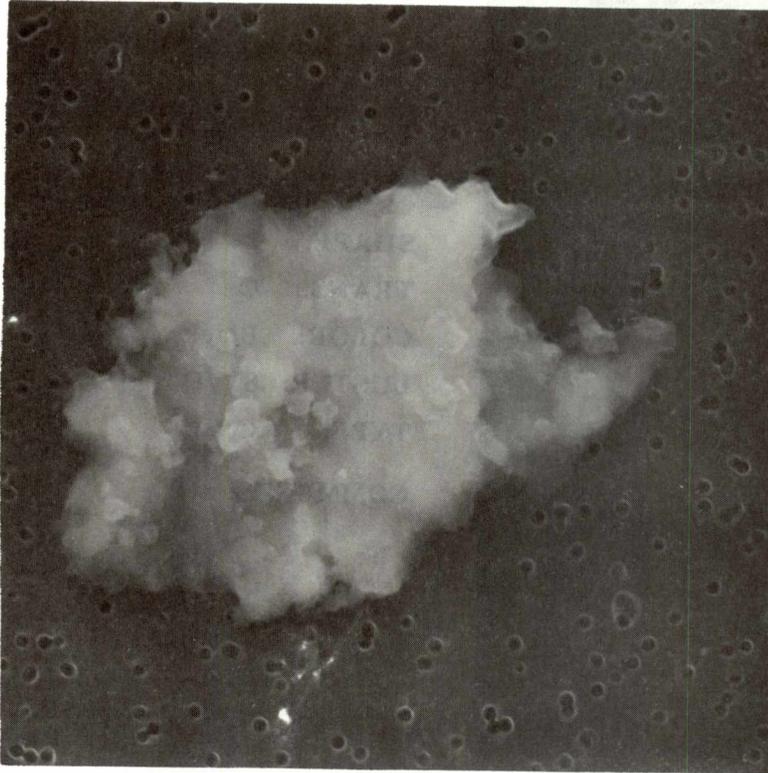
SIZE: 25x10
SHAPE: I
TRANS.: TL/O
COLOR: Yellow
LUSTER: V/SV
TYPE: C
COMMENTS:

S-85-42811

U22D14

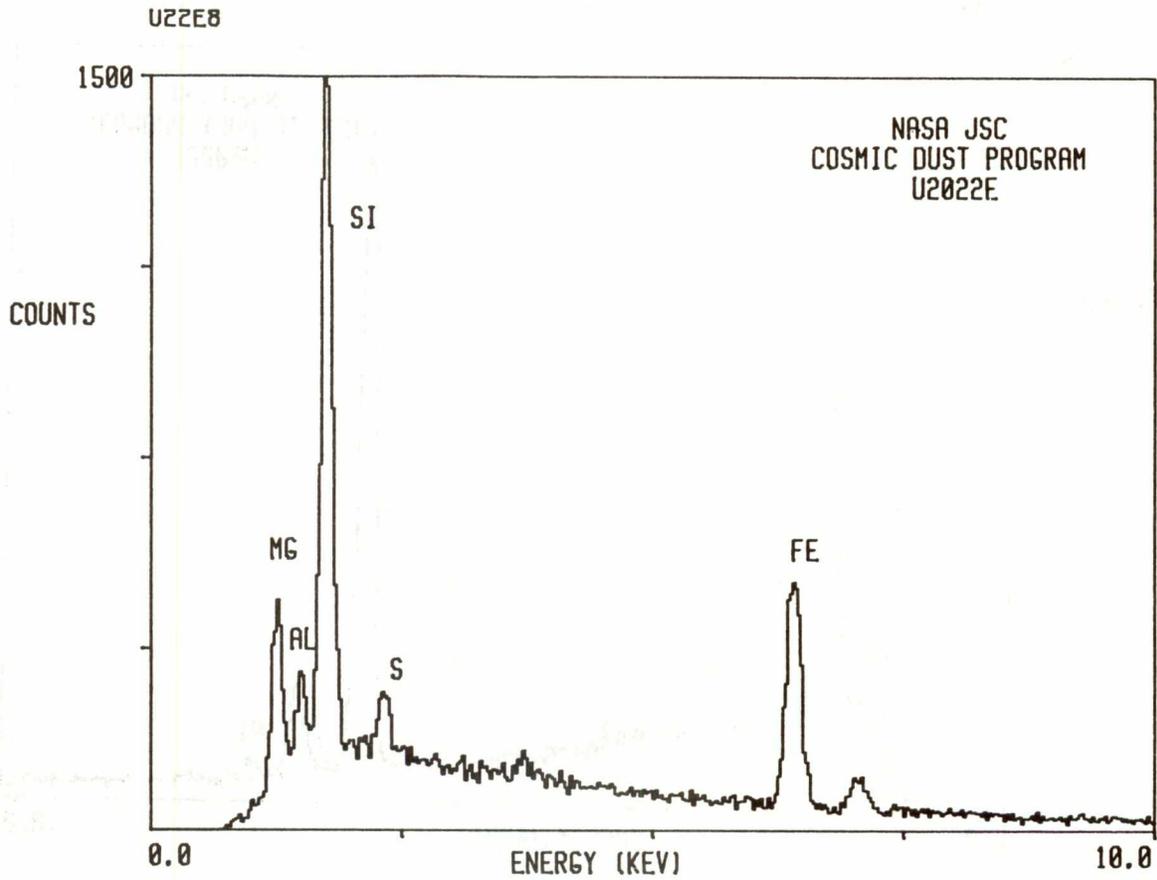


U2022 E 8

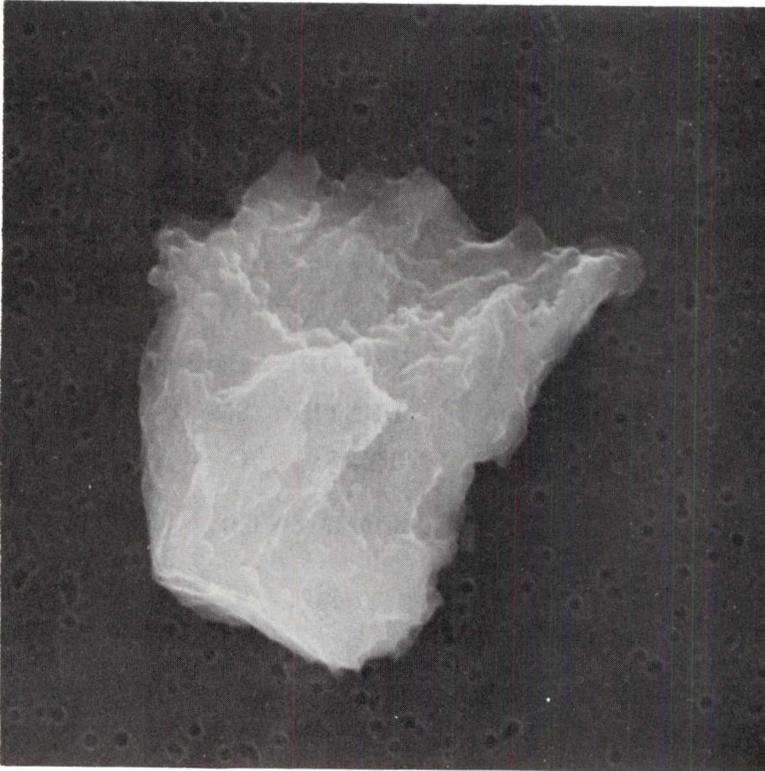


SIZE: 16x10
SHAPE: I
TRANS.: O
COLOR: Gold to Black
LUSTER: SM/D
TYPE: C
COMMENTS:

S-85-42830

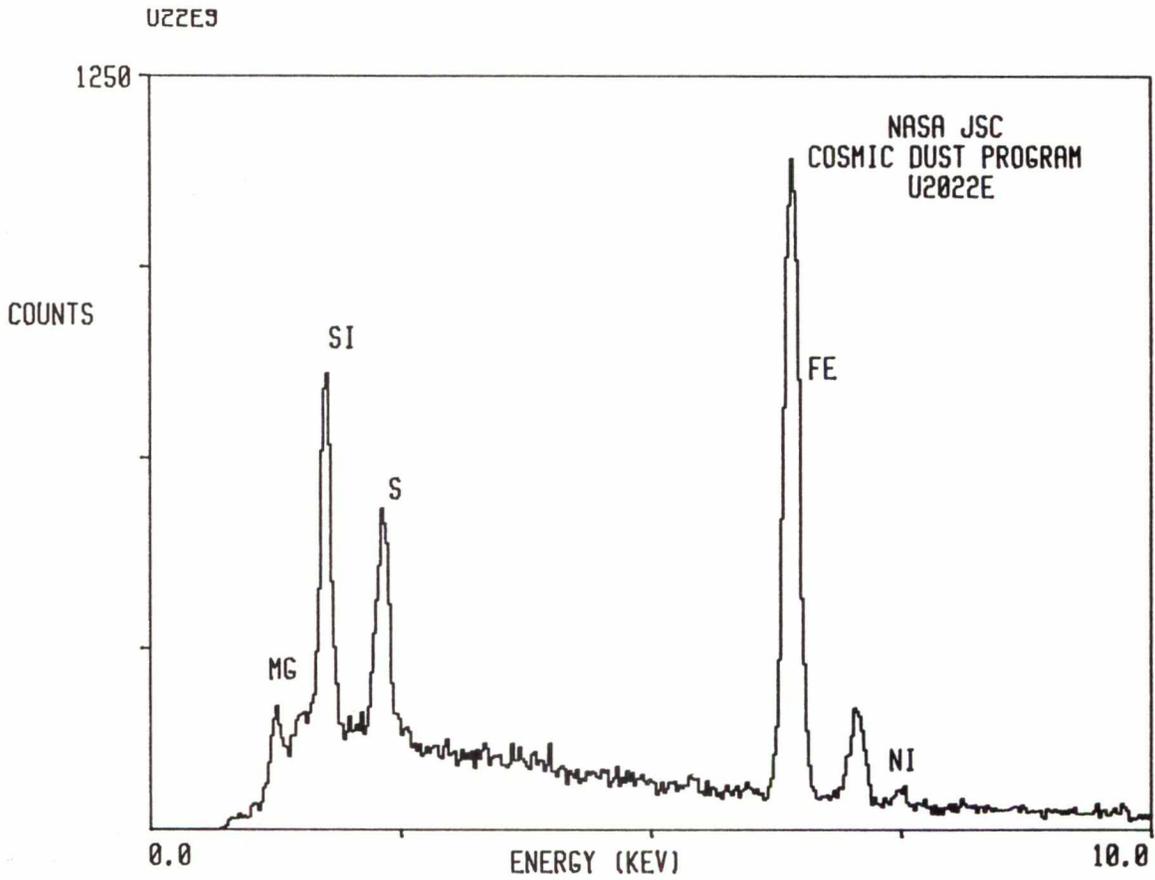


U2022 E 9

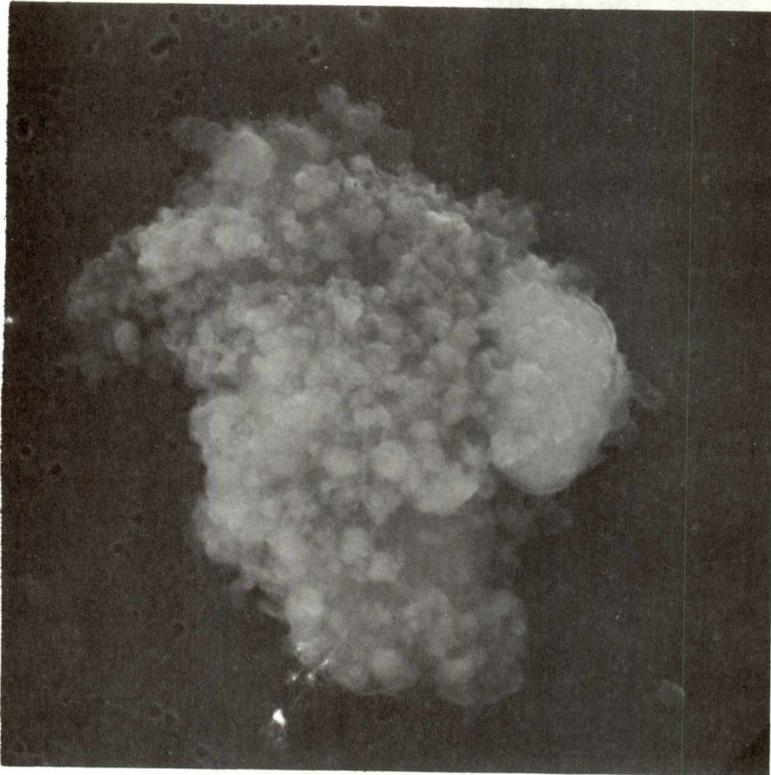


SIZE: 15
SHAPE: I
TRANS.: O
COLOR: Black
LUSTER: SV/D
TYPE: C
COMMENTS:

S-85-42829

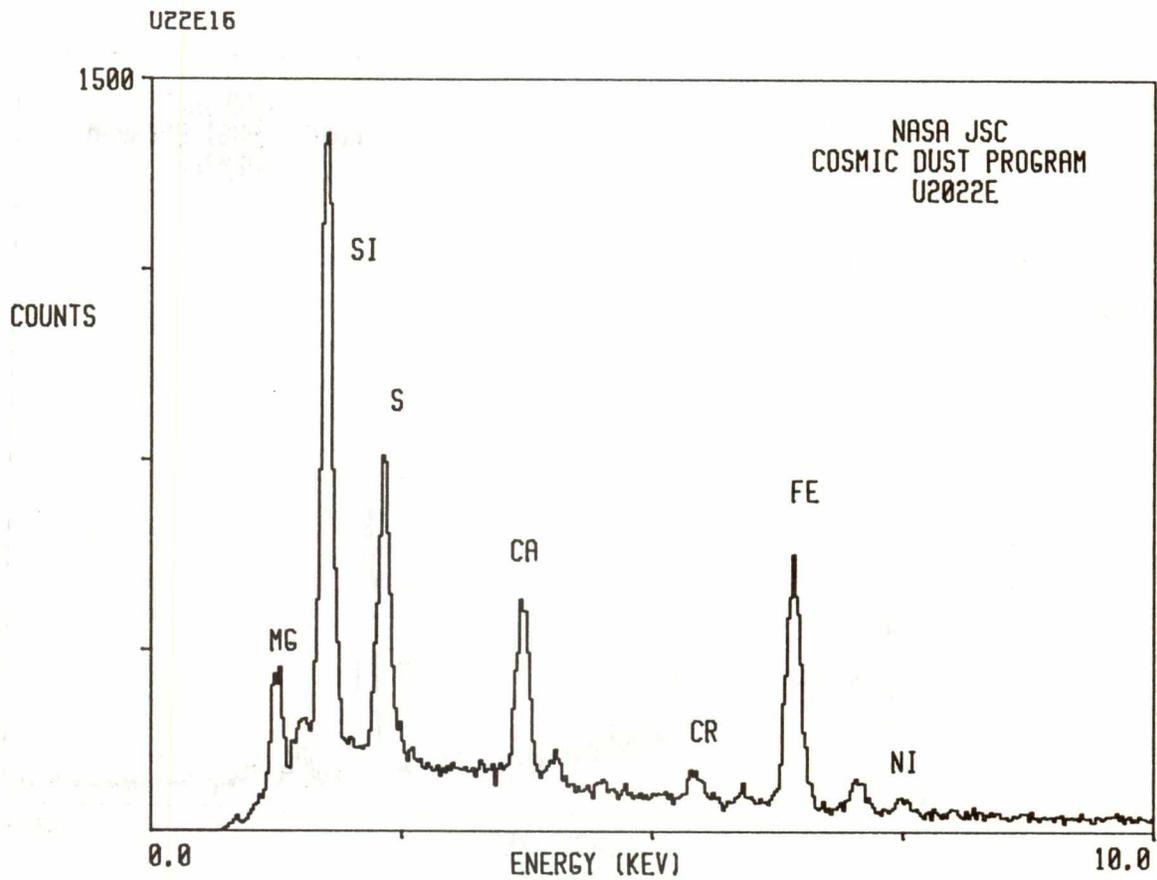


U2022 E 16

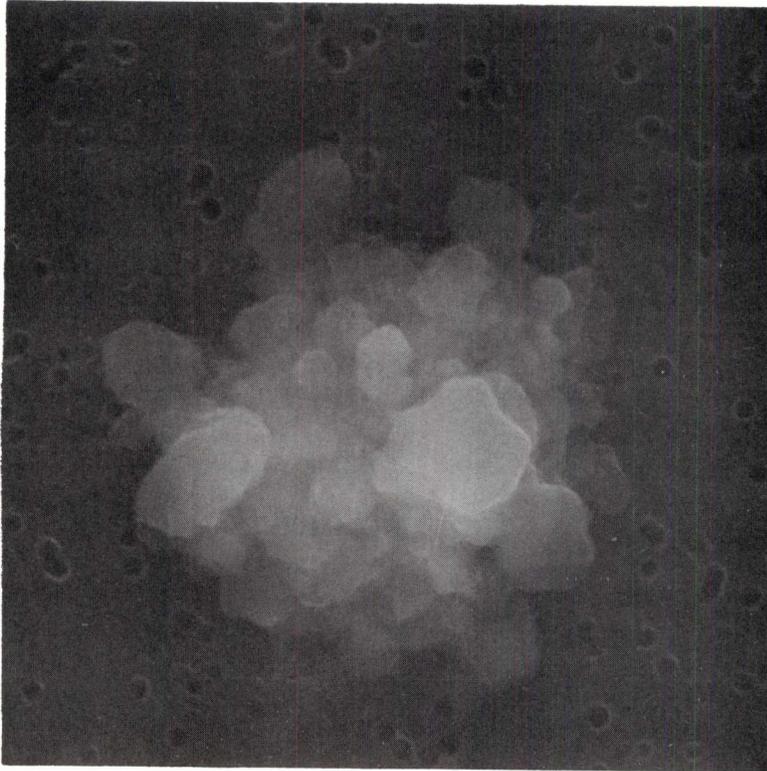


SIZE: 18
SHAPE: I
TRANS.: O
COLOR: Brown to Black
LUSTER: SM/D
TYPE: C
COMMENTS:

S-85-42837



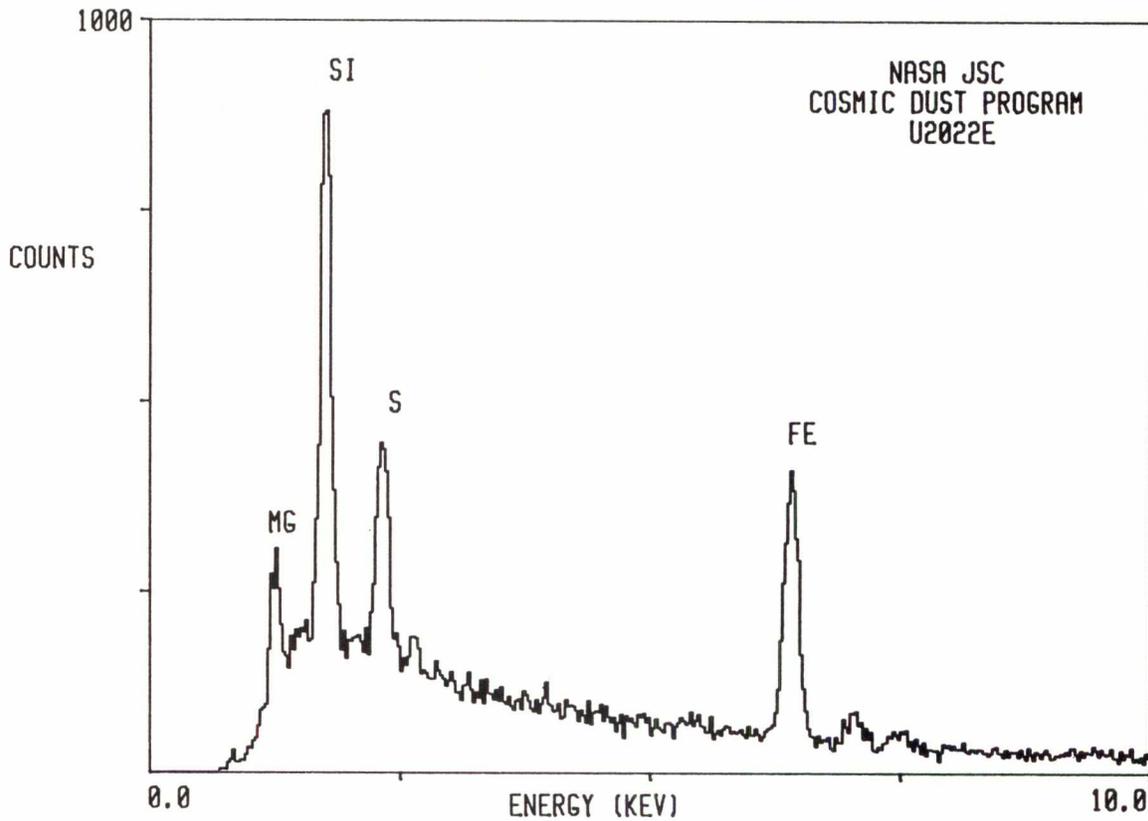
U2022 E 17



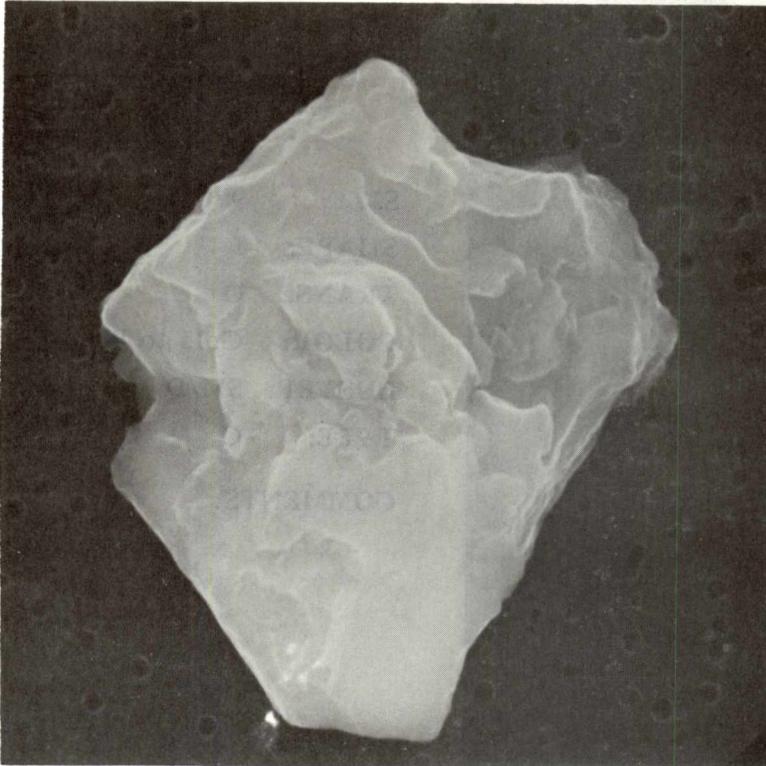
SIZE: 10
SHAPE: I
TRANS.: T/O
COLOR: Colorless to Black
LUSTER: V/D
TYPE: C
COMMENTS:

S-85-42838

U22E17

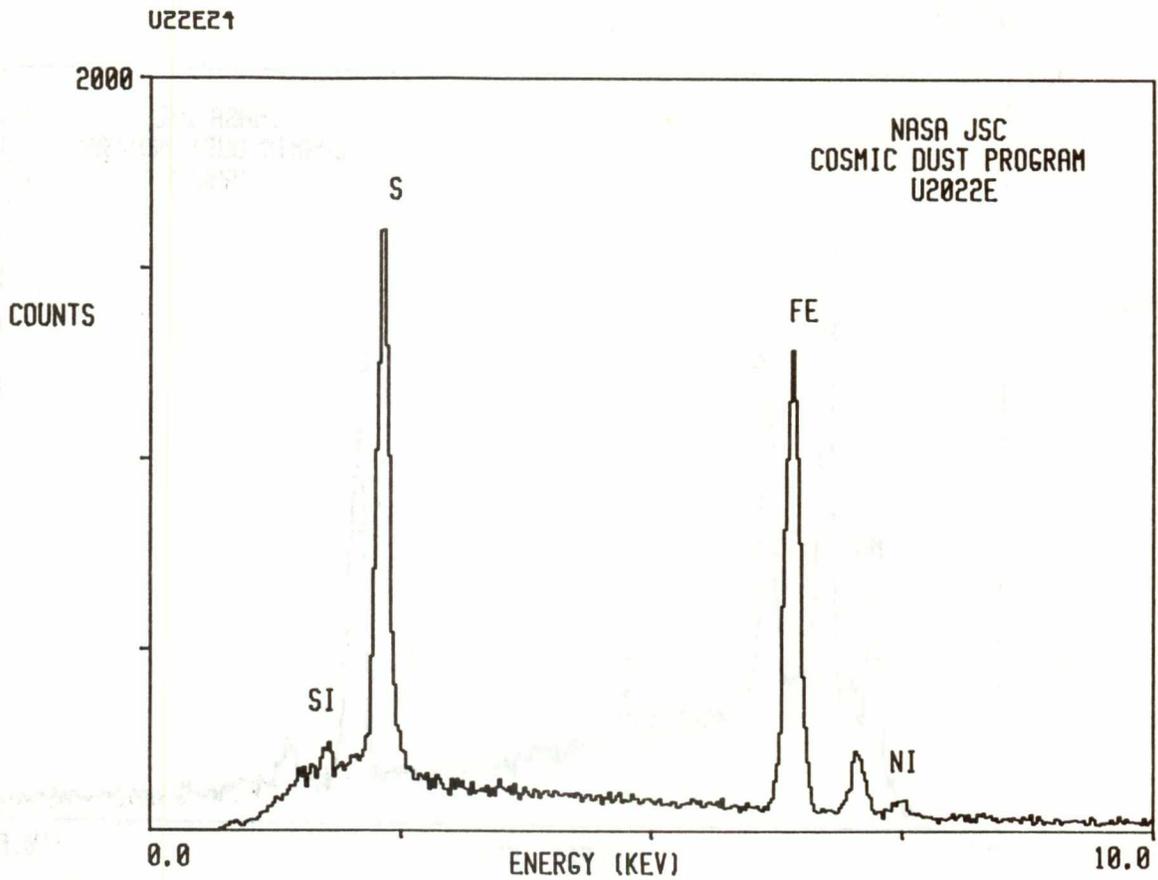


U2022 E 24

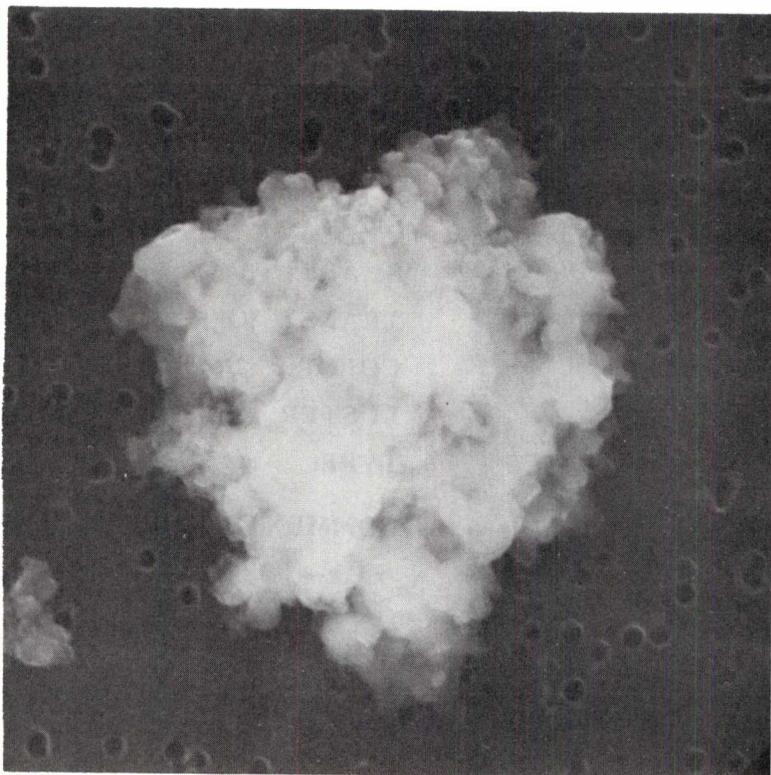


SIZE: 11x10
SHAPE: I
TRANS.: O
COLOR: Gold to Black
LUSTER: SM/D
TYPE: C
COMMENTS:

S-85-42845

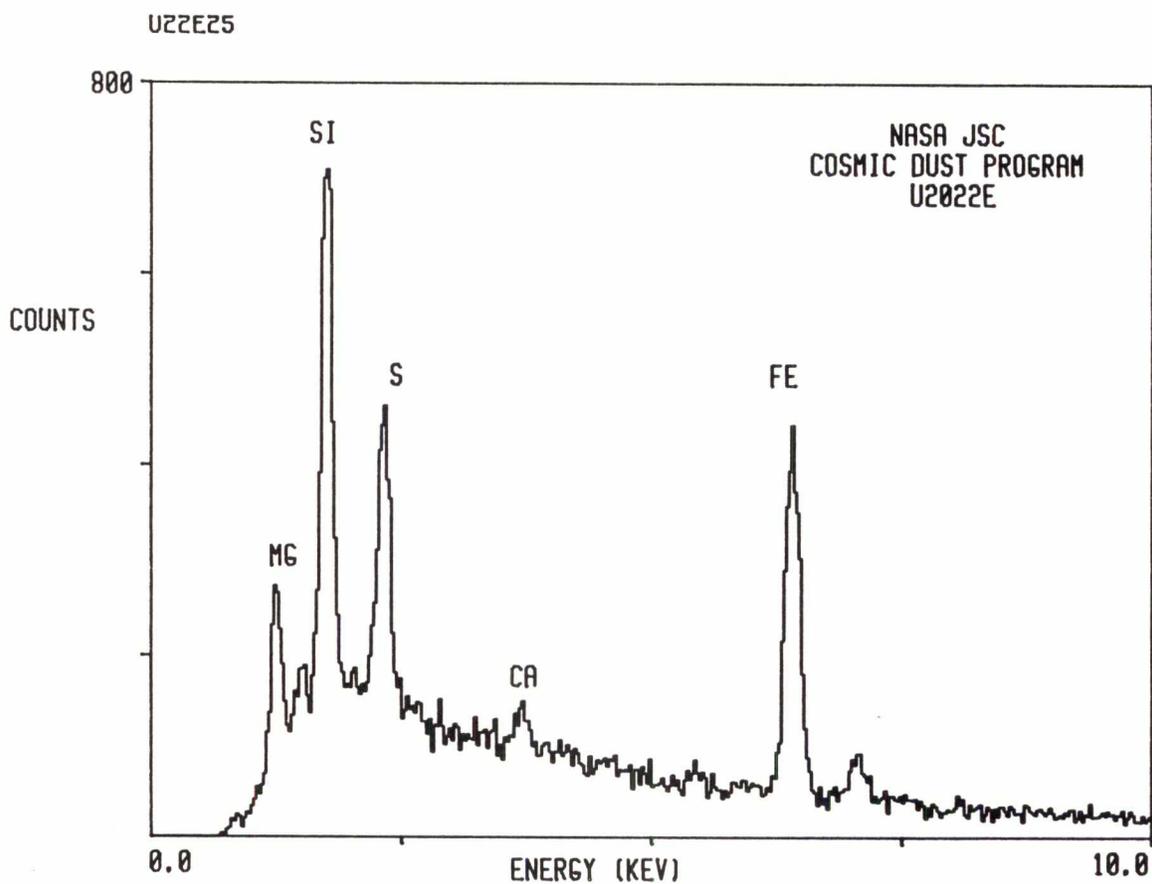


U2022 E 25

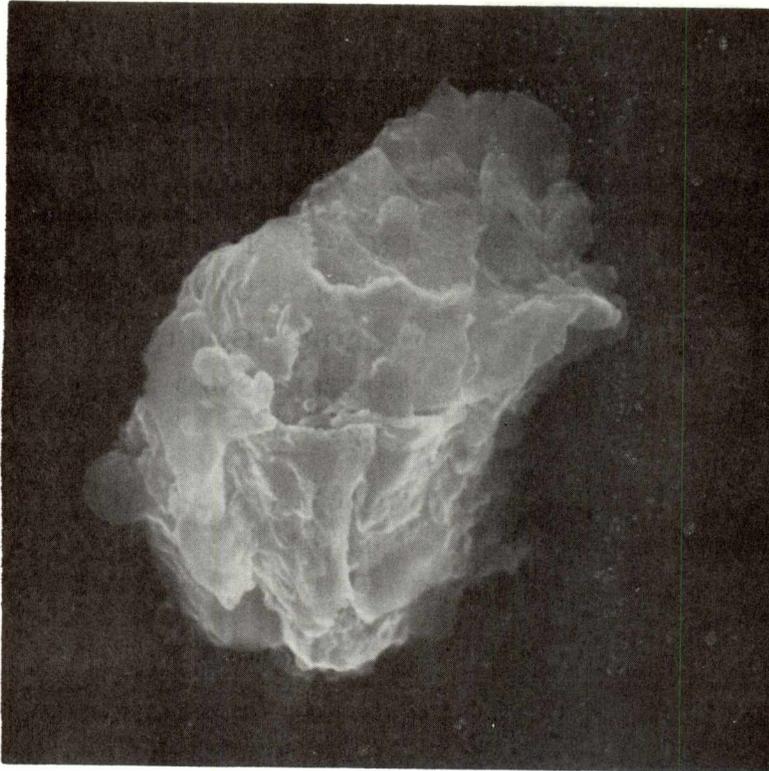


SIZE: 9
SHAPE: I
TRANS.: O
COLOR: Gold to Black
LUSTER: SM/D
TYPE: C
COMMENTS:

S-85-42846



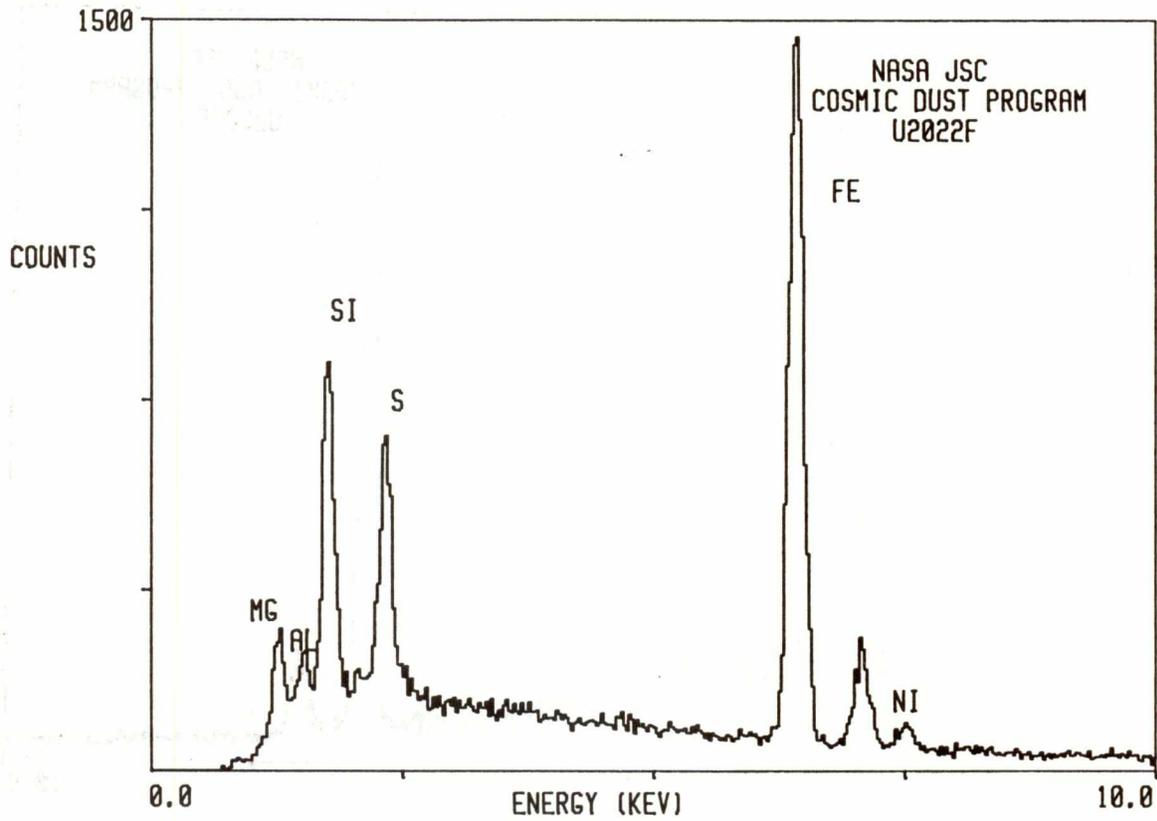
U2022 F 4



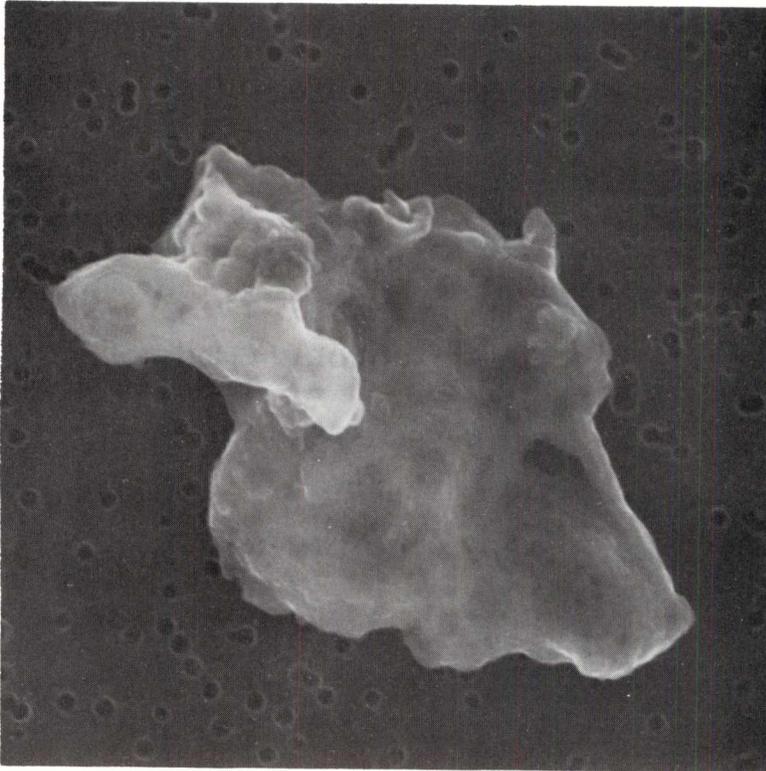
SIZE: 20x12
SHAPE: I
TRANS.: T/O
COLOR: Colorless,
Brown and Black
LUSTER: V/D
TYPE: C
COMMENTS:

S-85-42860

U22F1

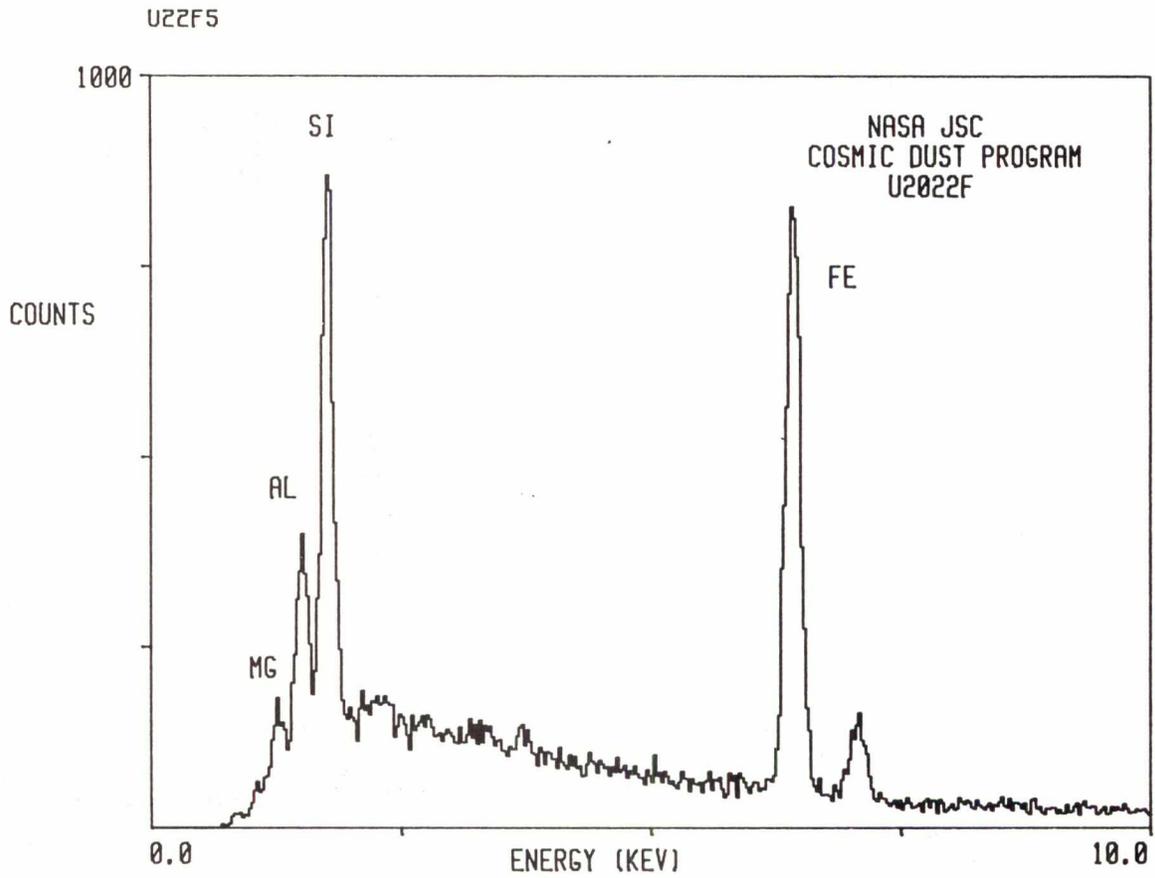


U2022 F 5

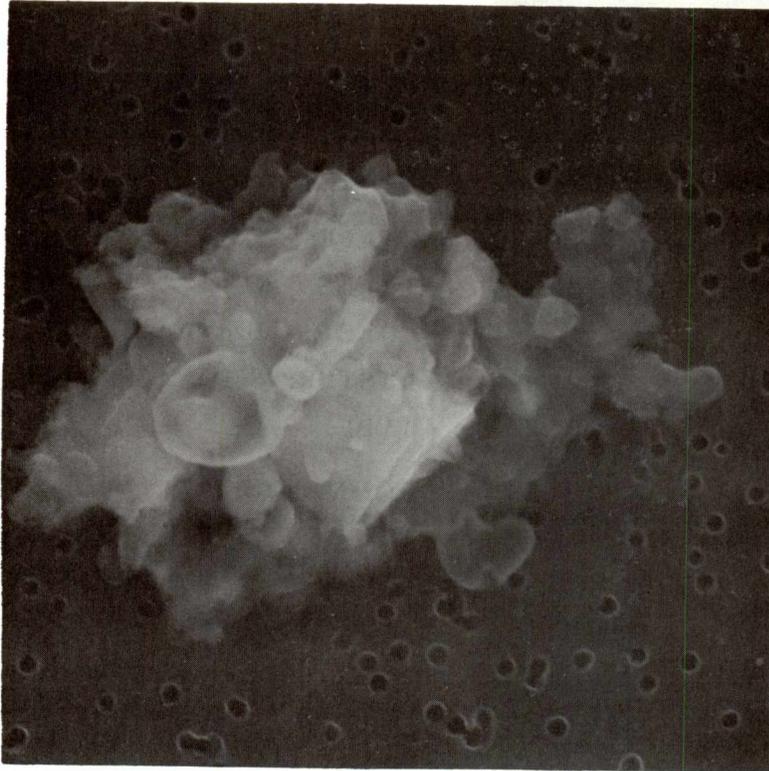


SIZE: 16x11
SHAPE: I
TRANS.: O
COLOR: Gold to Brown
LUSTER: SM/D
TYPE: C
COMMENTS:

S-85-42861

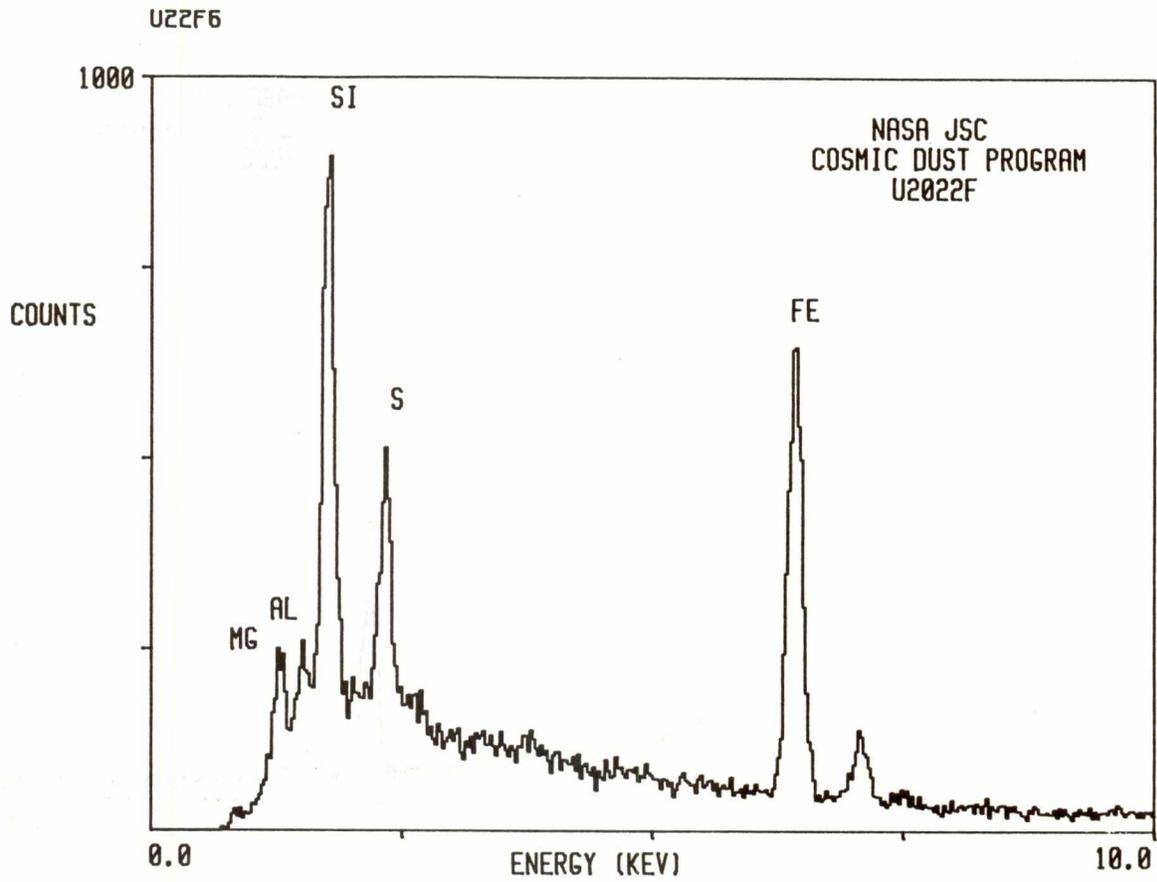


U2022 F 6

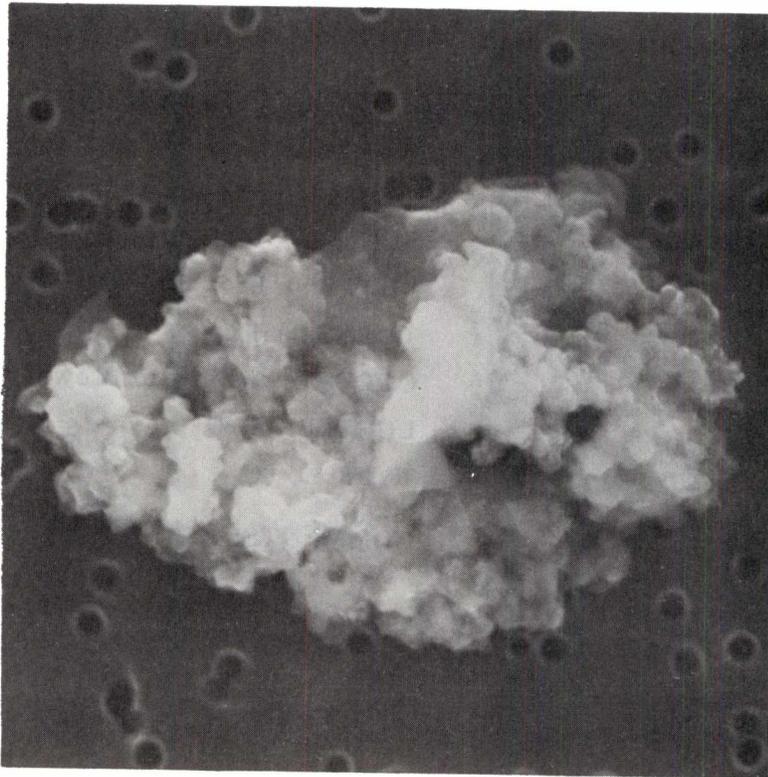


SIZE: 14x9
SHAPE: I
TRANS.: TL
COLOR: Yellow to Brown
LUSTER: V/D
TYPE: C
COMMENTS:

S-85-42862

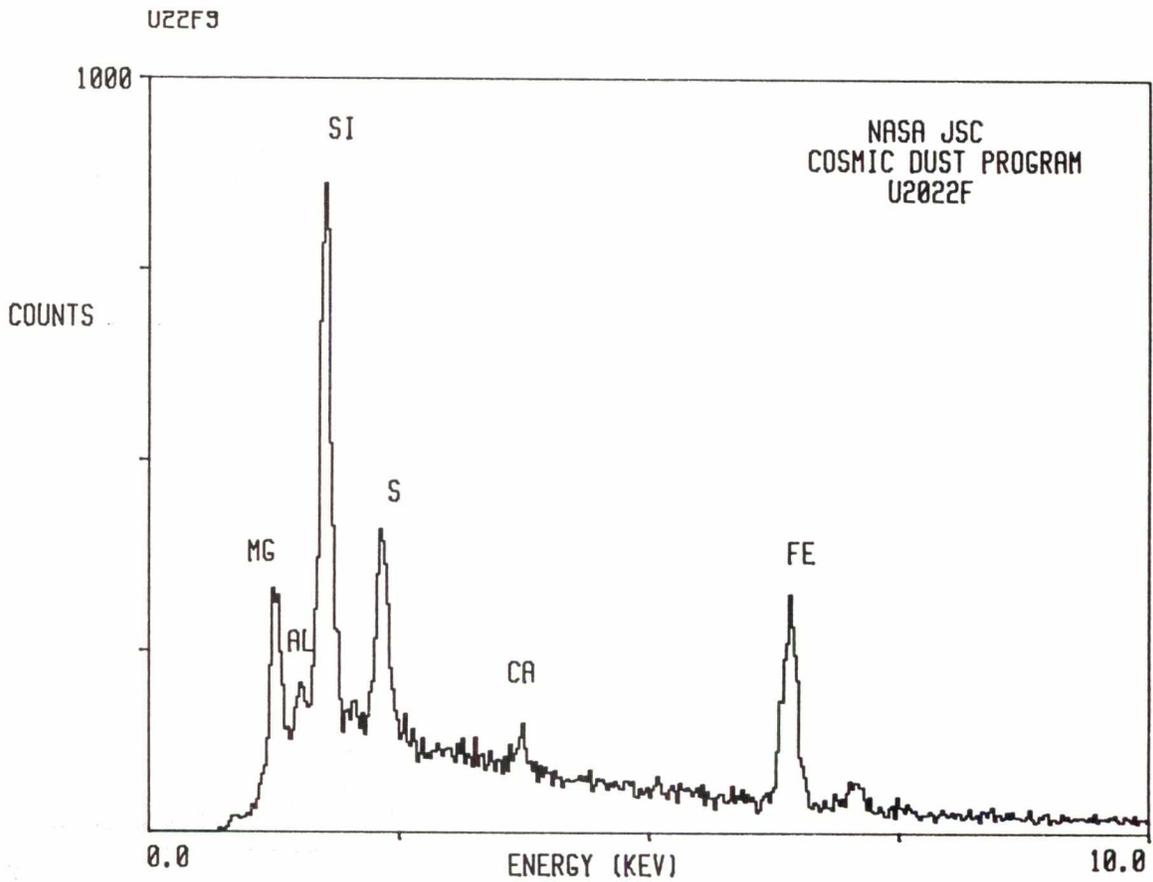


U2022 F 9

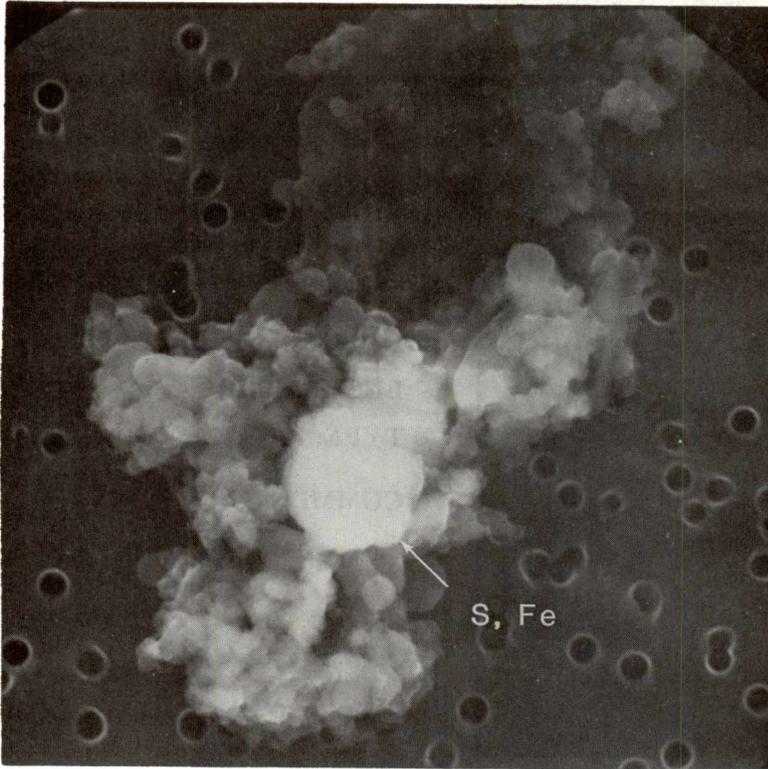


SIZE: 8
SHAPE: I
TRANS.: O
COLOR: Brown to Black
LUSTER: SM/D
TYPE: C
COMMENTS:
Related to U2022F10

S-85-42855



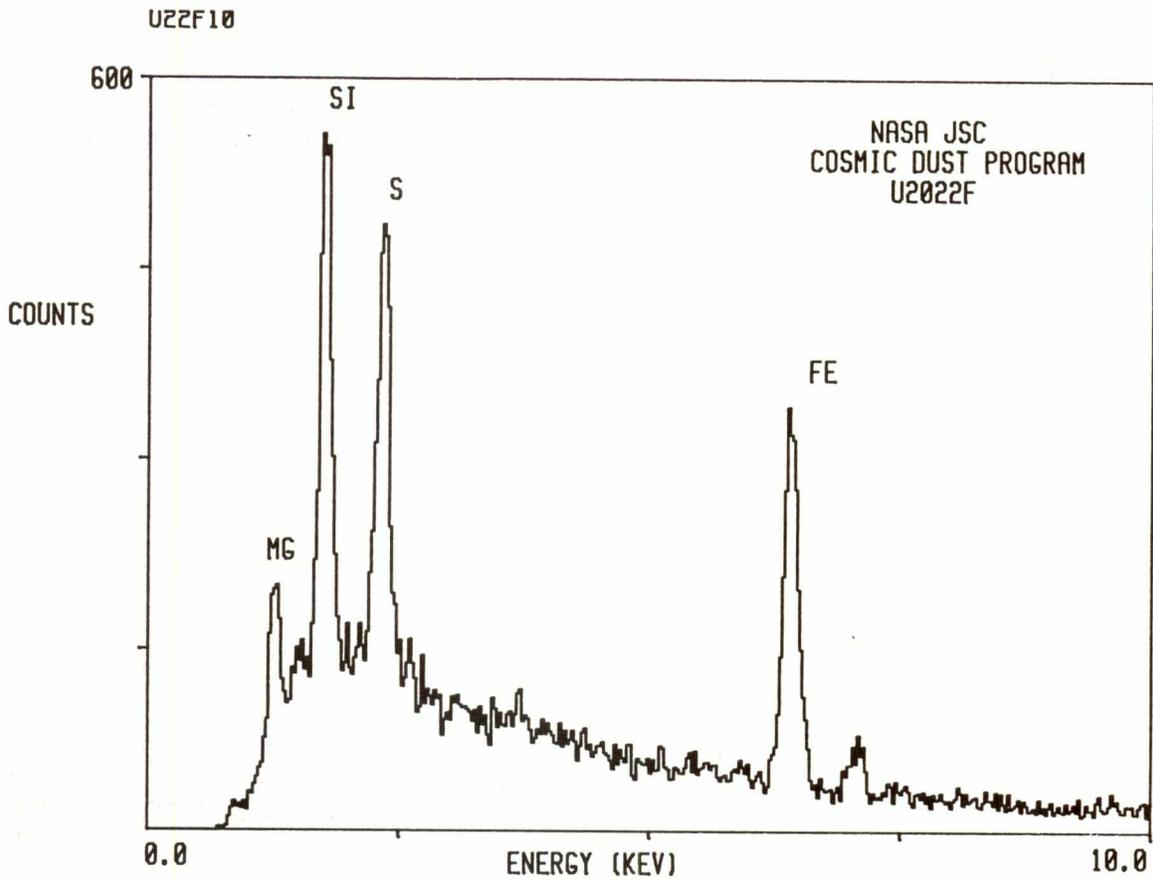
U2022 F 10



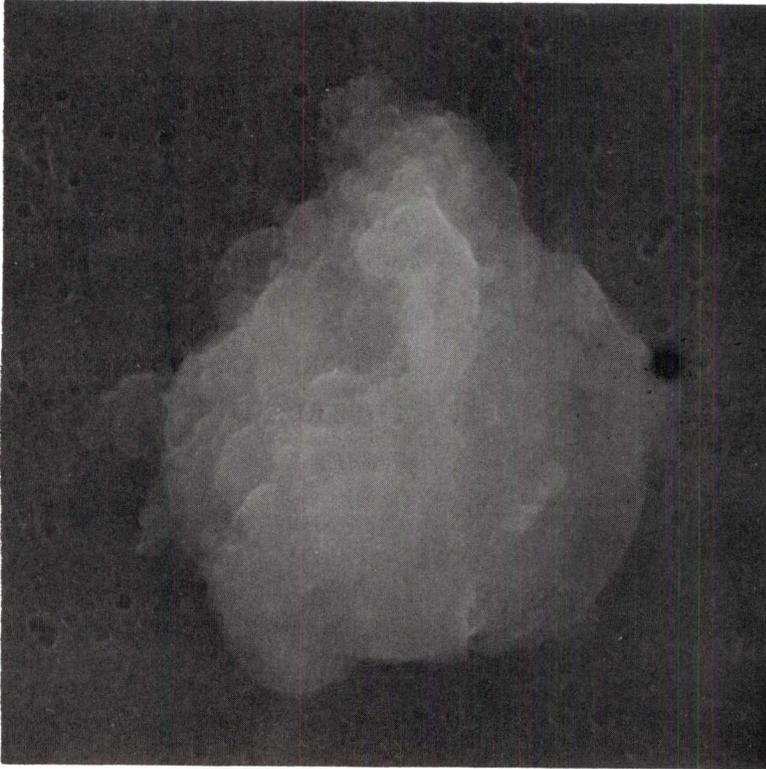
SIZE: 9x7
SHAPE: I
TRANS.: O
COLOR: Gold to Black
LUSTER: D
TYPE: C

COMMENTS:
Related to
U2022F9; seems to
be attached to
much longer
particle

S-85-42856

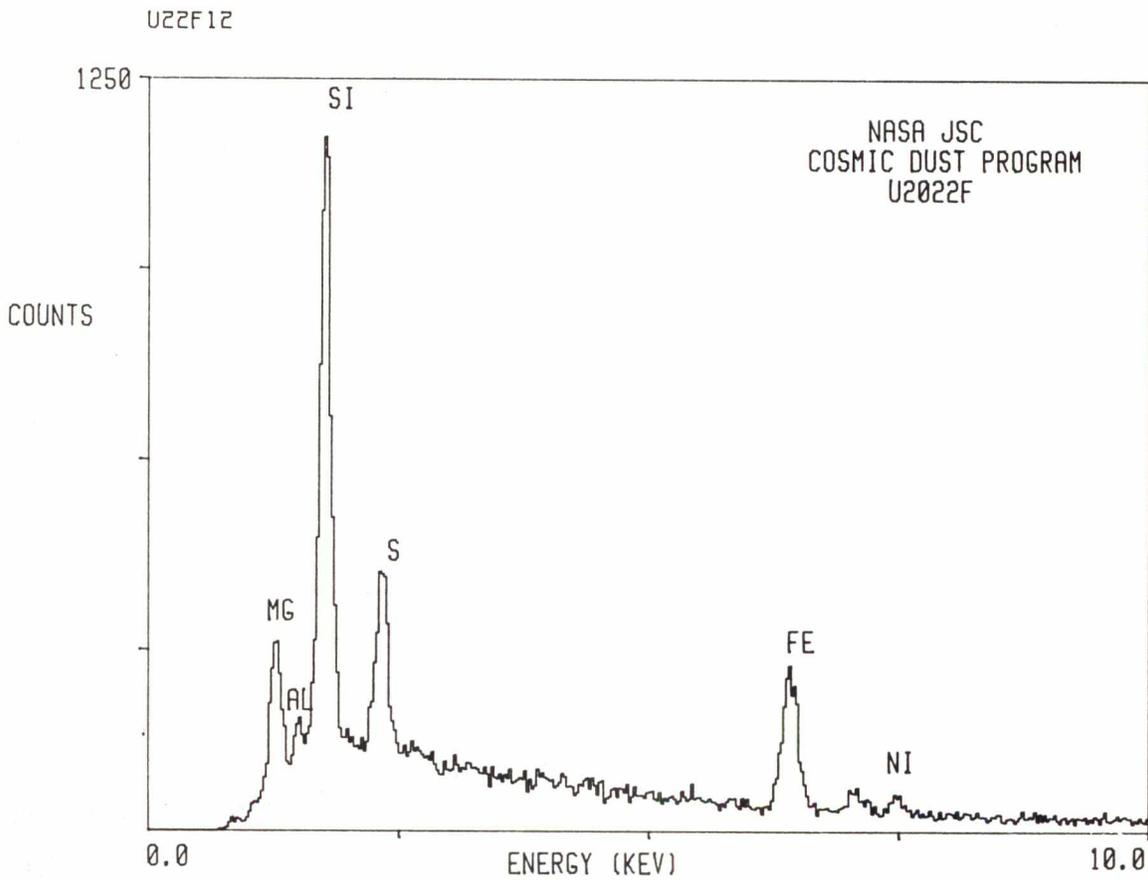


U2022 F 12

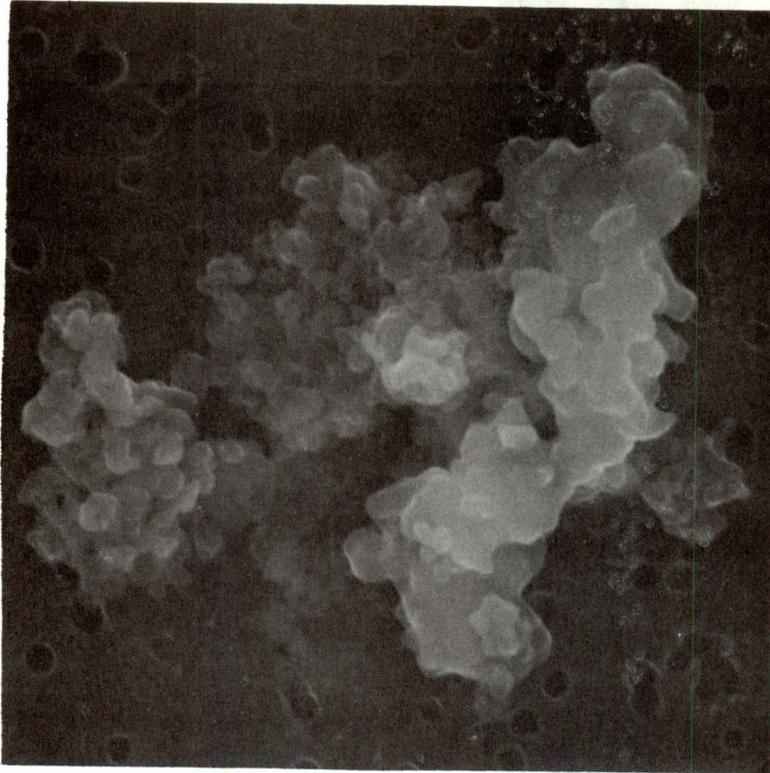


SIZE: 11
SHAPE: I
TRANS.: O
COLOR: Brown to Black
LUSTER: D
TYPE: C
COMMENTS:

S-85-42867



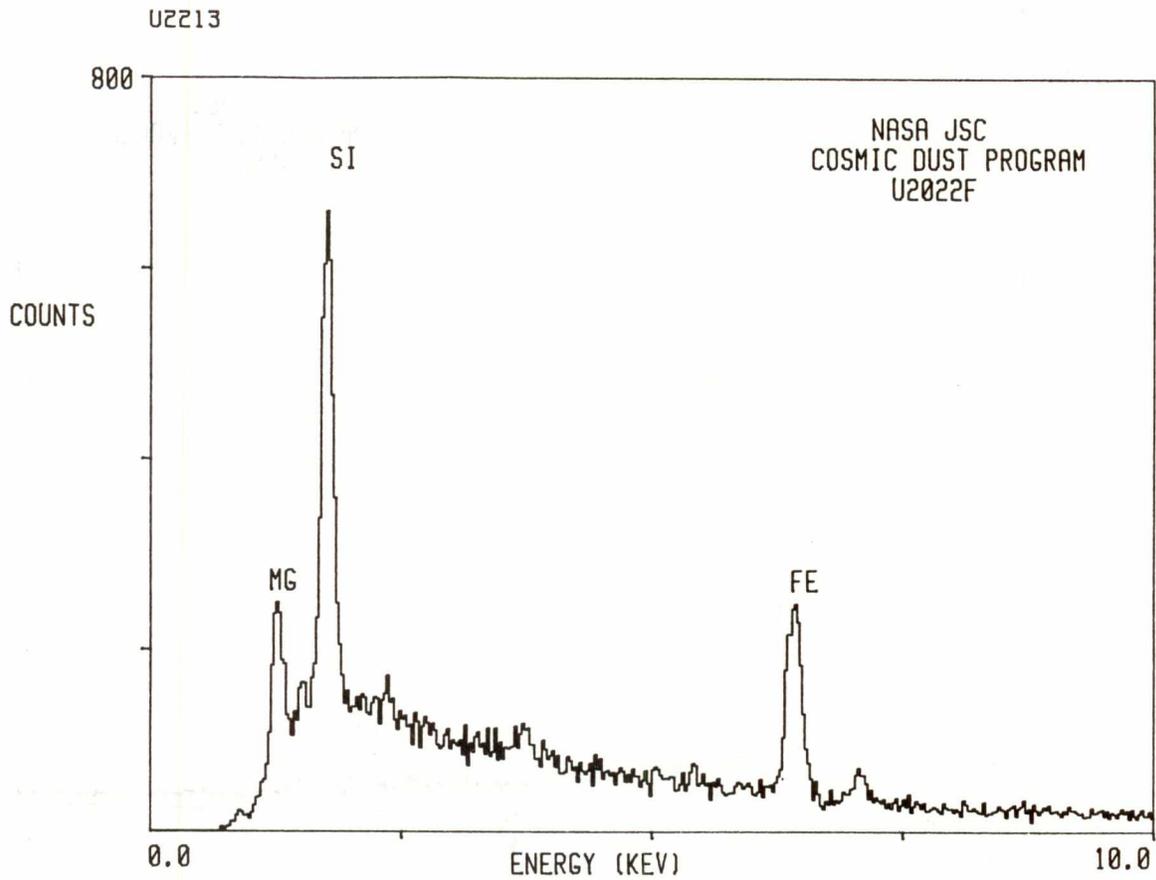
U2022 F 13



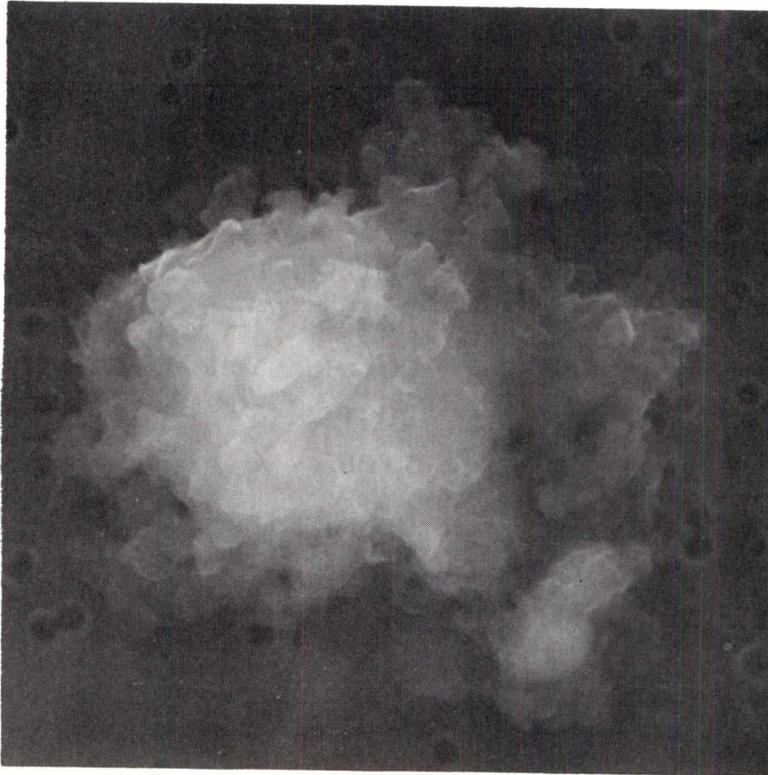
SIZE: 10x9
SHAPE: I
TRANS.: TL
COLOR: Yellow
LUSTER: SV
TYPE: C

COMMENTS:
Associated with 2
smaller grains

S-85-42866



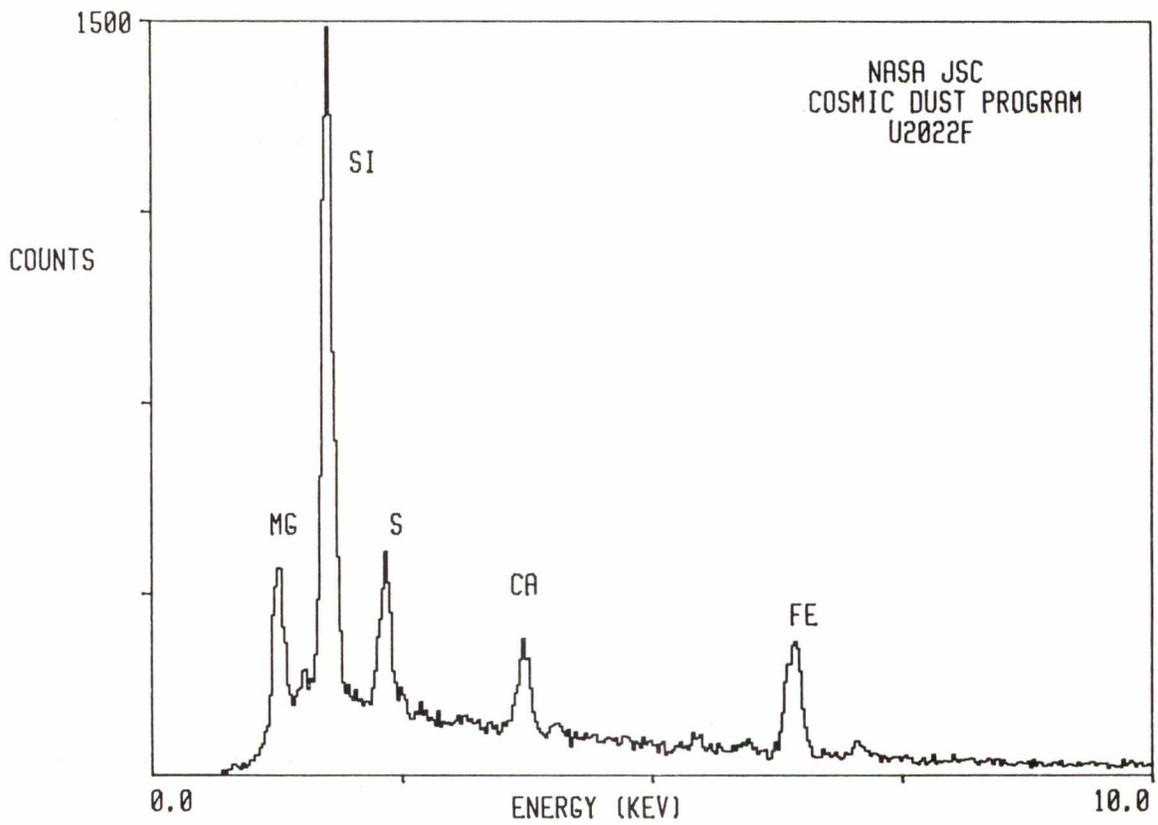
U2022 F 15



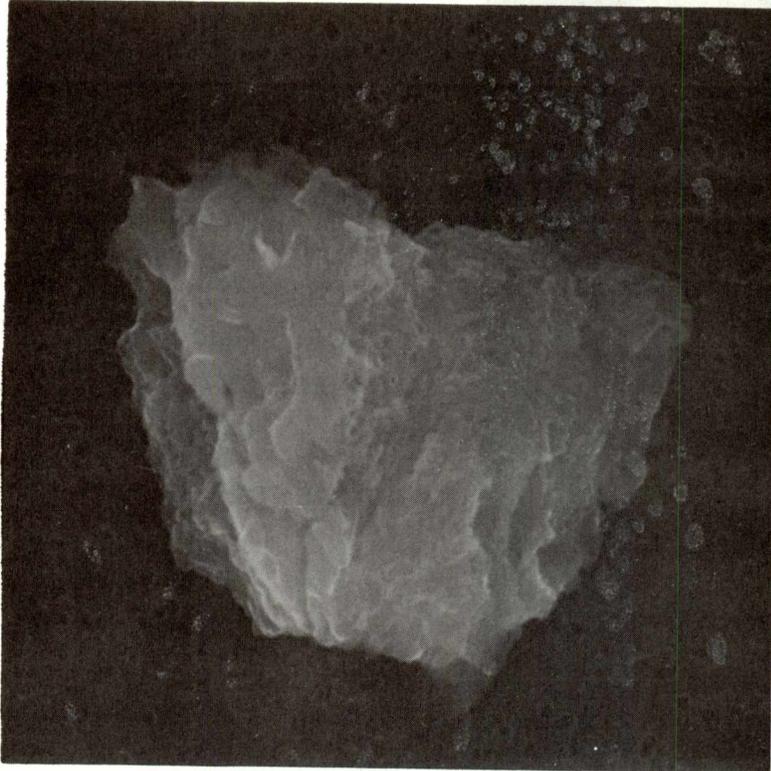
SIZE: 9
SHAPE: I
TRANS.: O
COLOR: Gold to Brown
LUSTER: SM/D
TYPE: C?
COMMENTS:

S-85-42864

U22F15



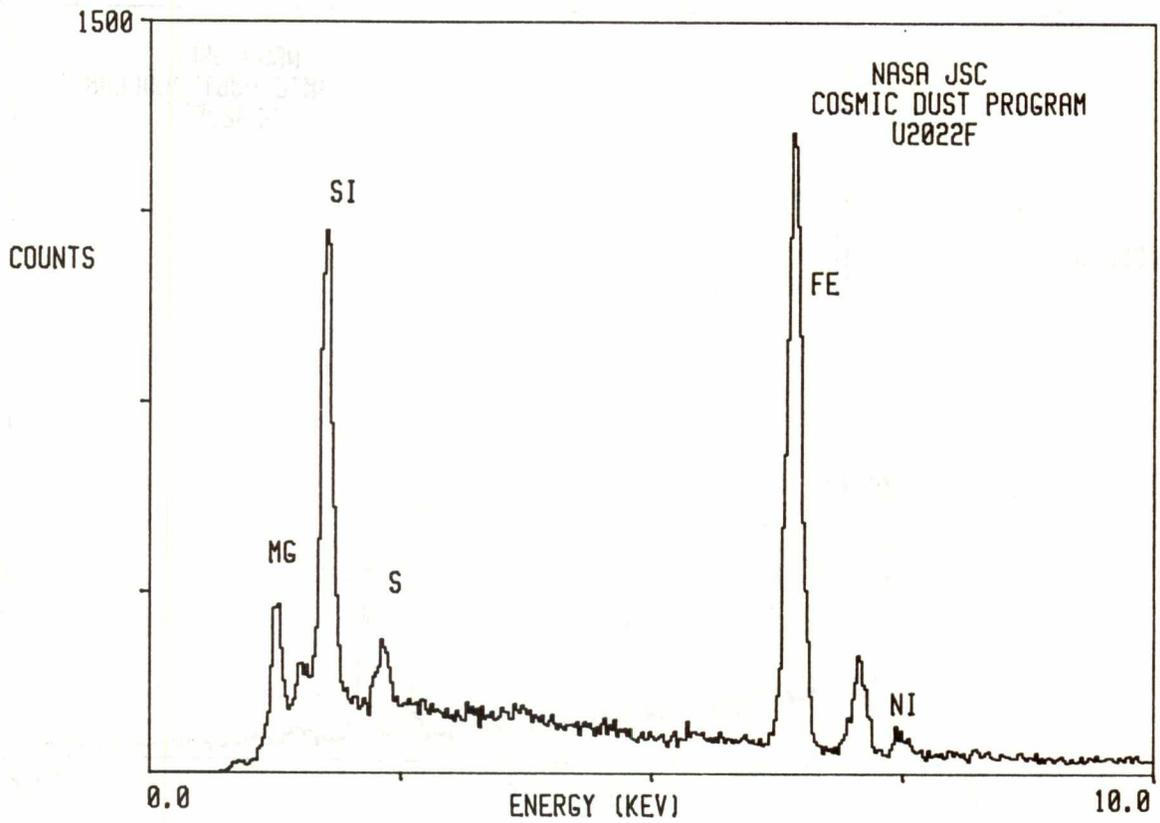
U2022 F 17



SIZE: 15x13
SHAPE: I
TRANS.: O
COLOR: Gold to Black
LUSTER: SM/D
TYPE: C
COMMENTS:

S-85-42869

U22F17

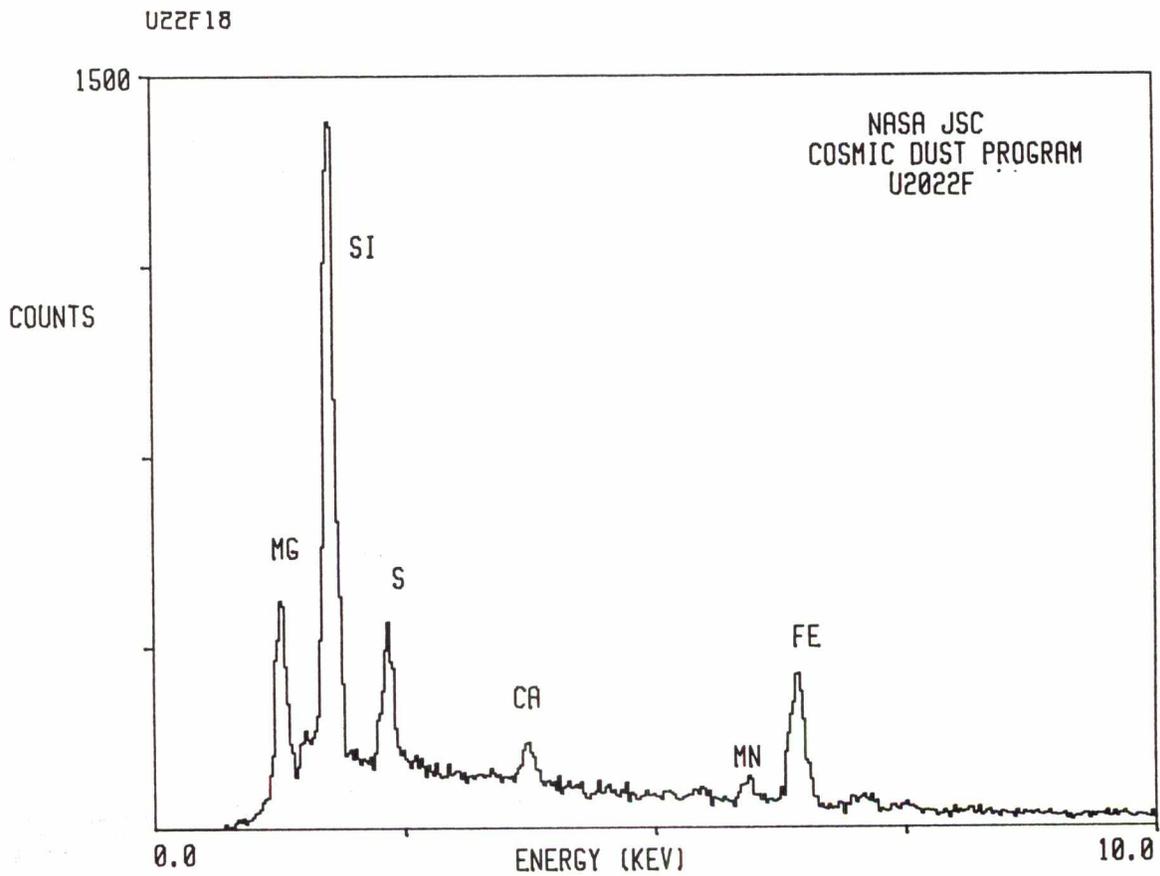


U2022 F 18

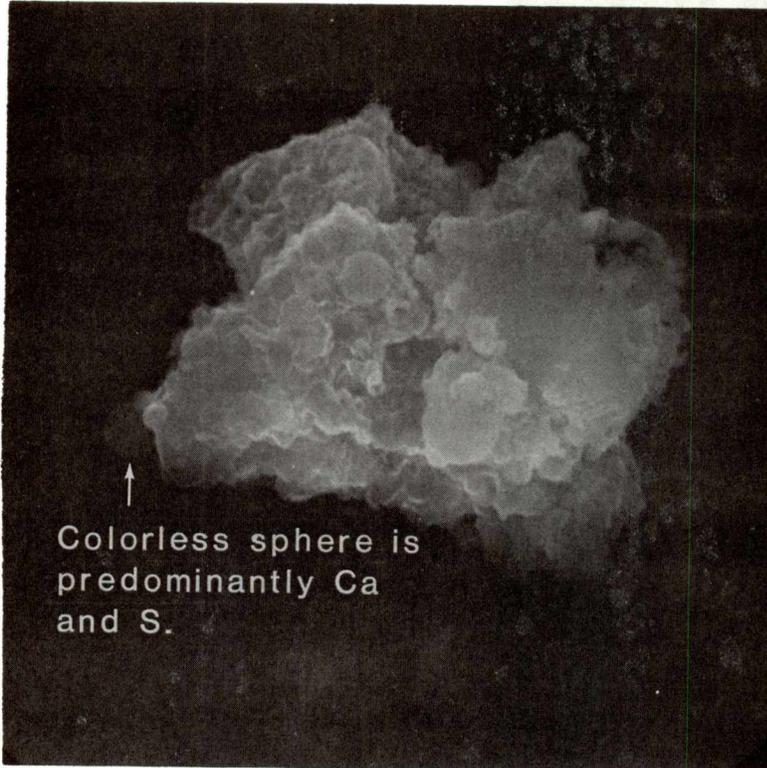


SIZE: 15
SHAPE: I
TRANS.: O
COLOR: Gold to Black
LUSTER: SM/D
TYPE: C
COMMENTS:

S-85-42868



U2022 G 1

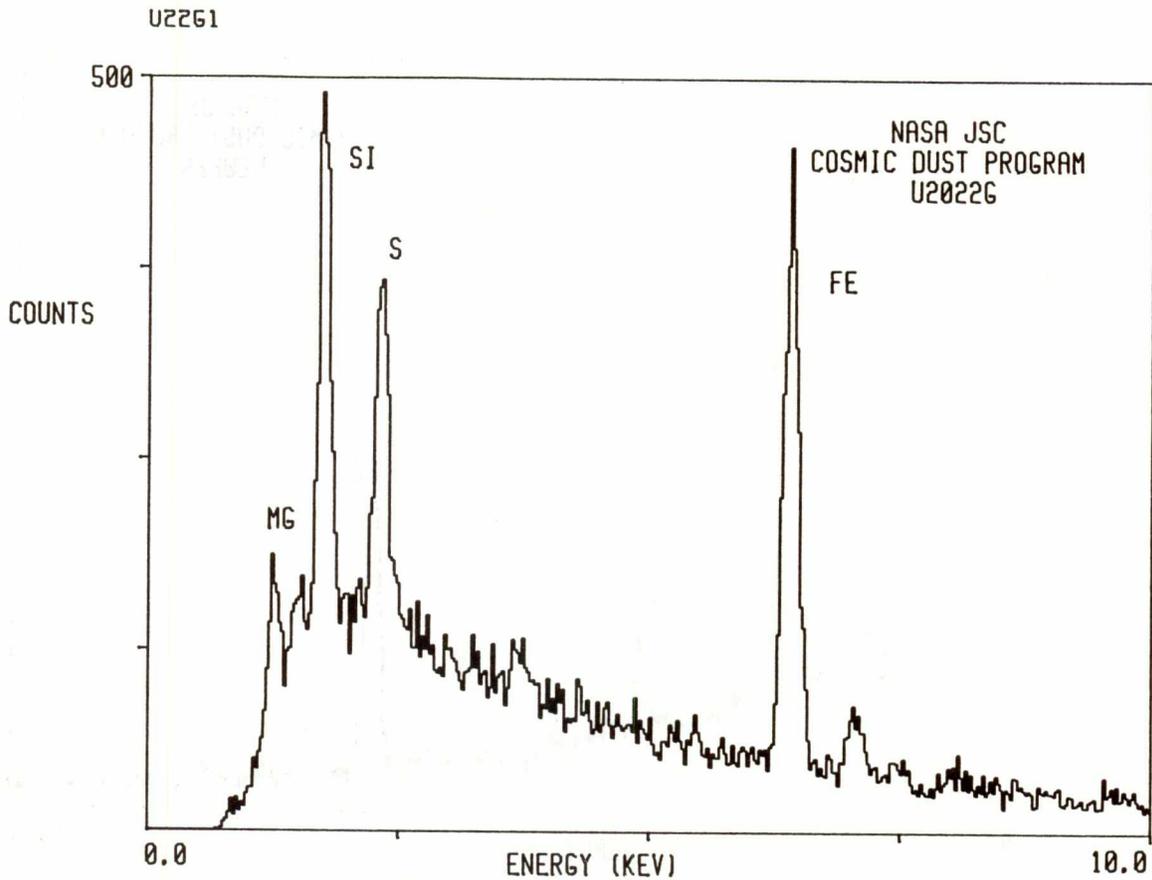


SIZE: 30x20
SHAPE: I
TRANS.: O
COLOR: Gold, Yellow, Clear, and Black

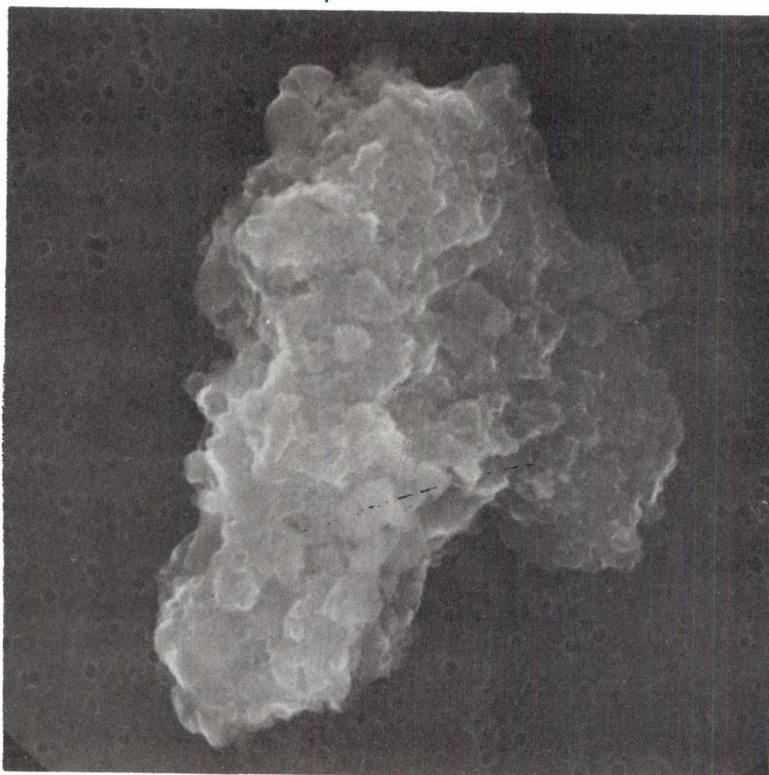
LUSTER:
TYPE: C

COMMENTS:
Related to U2022G2 and 3, also U2022A3 and 4

S-85-42876



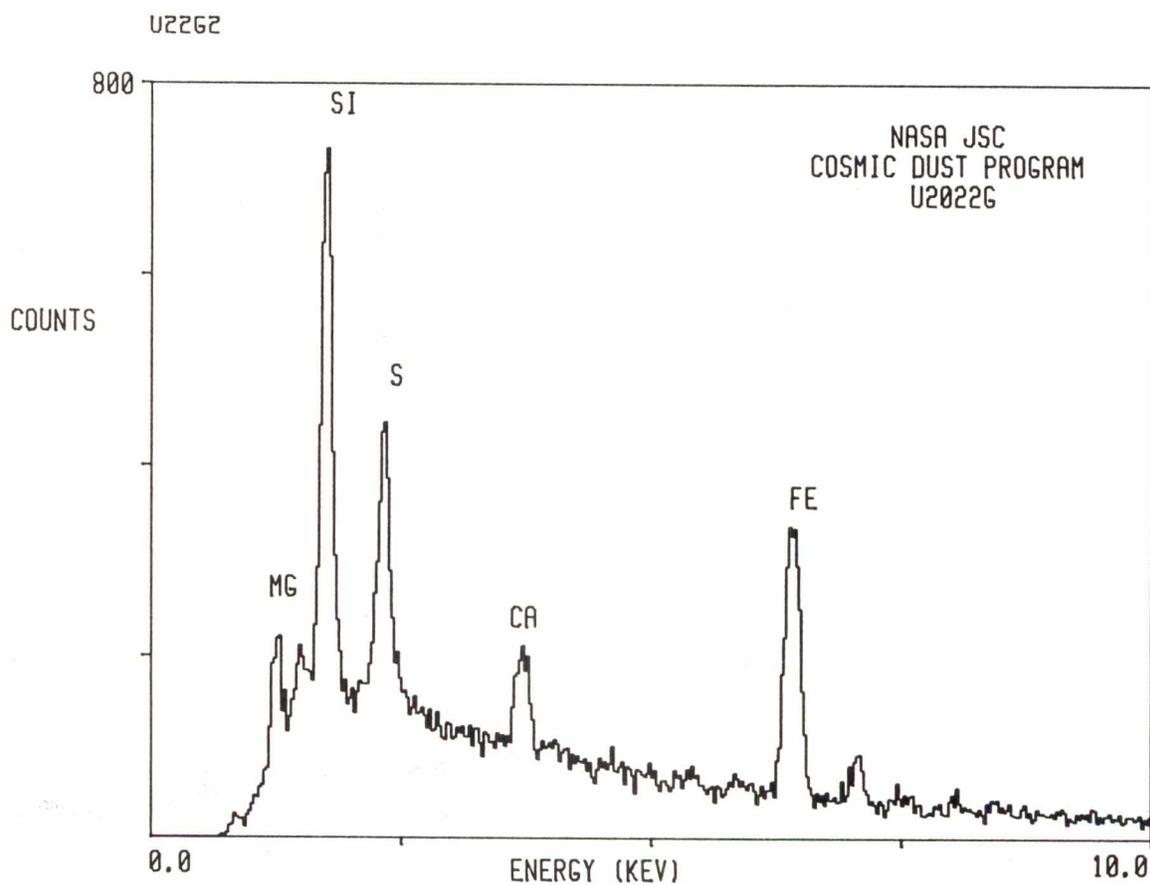
U2022 G 2



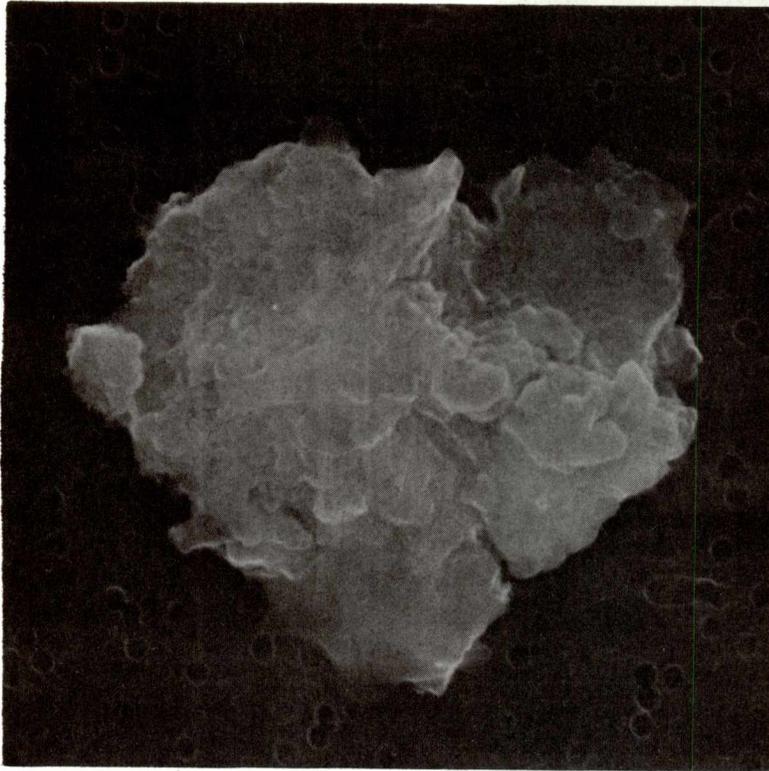
SIZE: 20x15
SHAPE: I
TRANS.: O
COLOR: Gold to Black
LUSTER: SM/D
TYPE: C

COMMENTS:
Related to U2022G1
and 3, also
U2022A3 and 4

S-85-42877



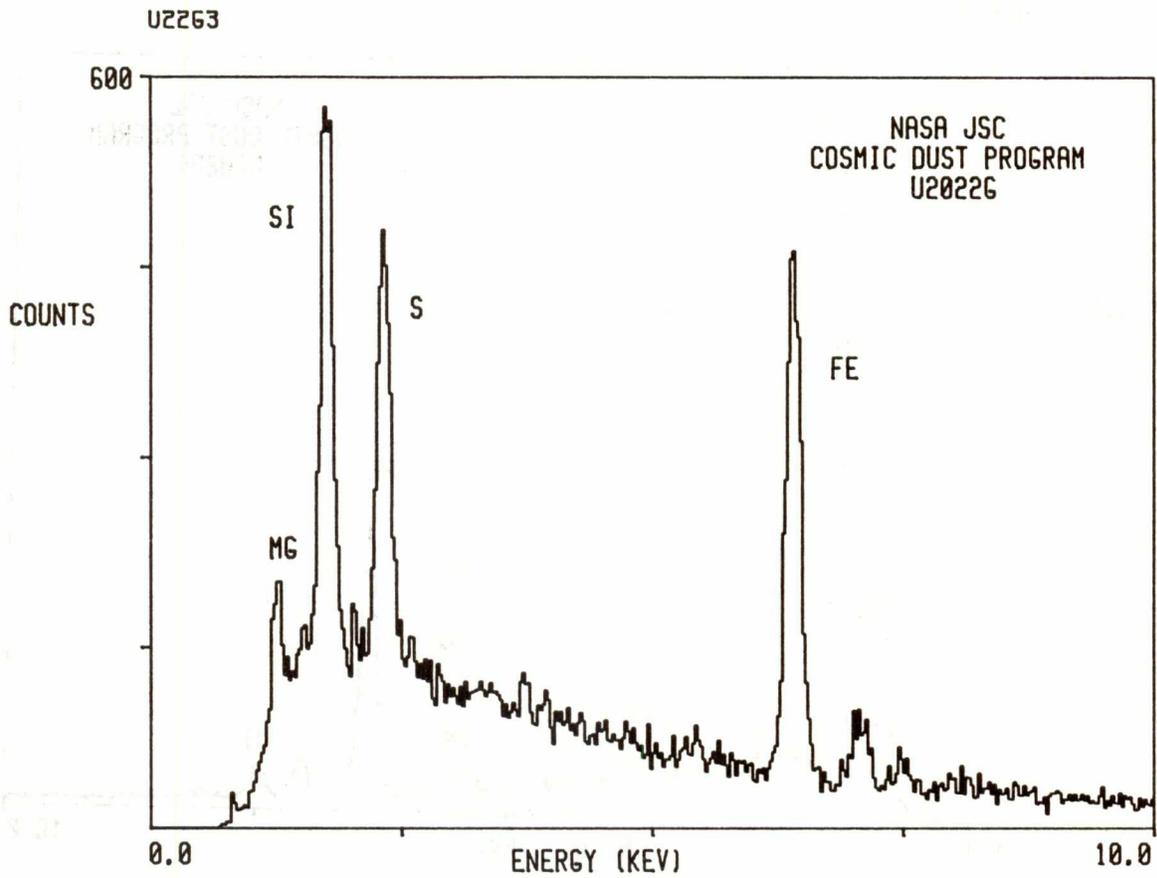
U2022 G 3



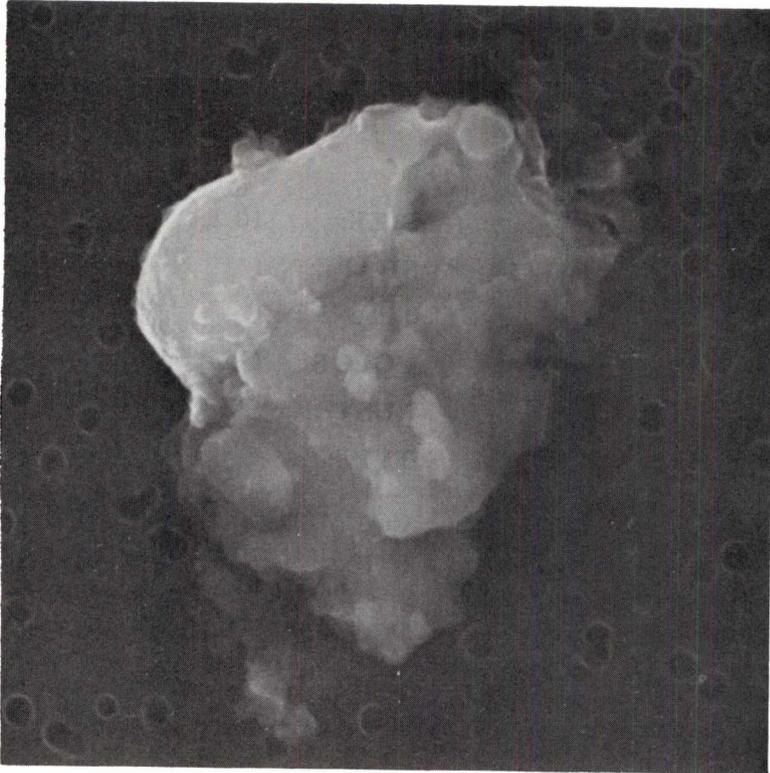
SIZE: 10
SHAPE: I
TRANS.: O
COLOR: Gold to Black
LUSTER: SM/D
TYPE: C

COMMENTS:
Related to U2022G1
and 2, also
U2022A3 and 4

S-85-42878

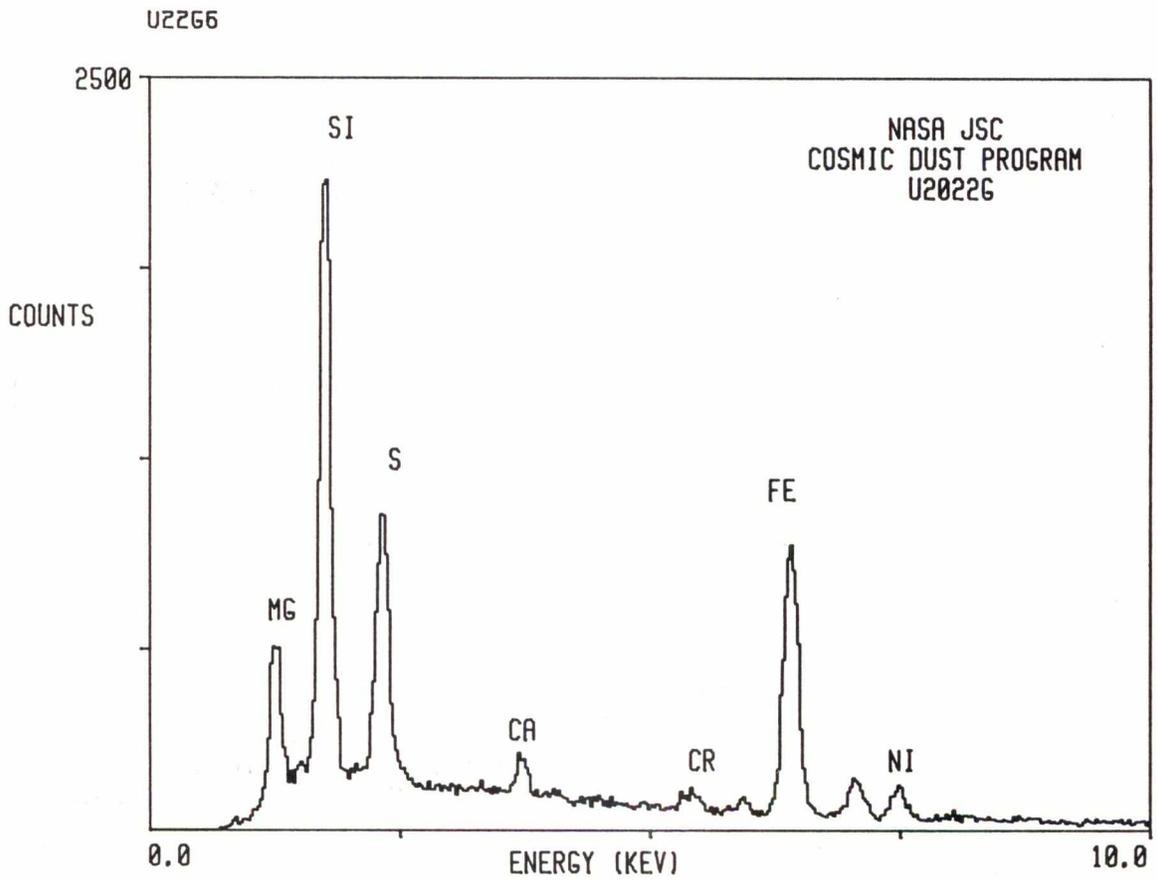


U2022 G 6

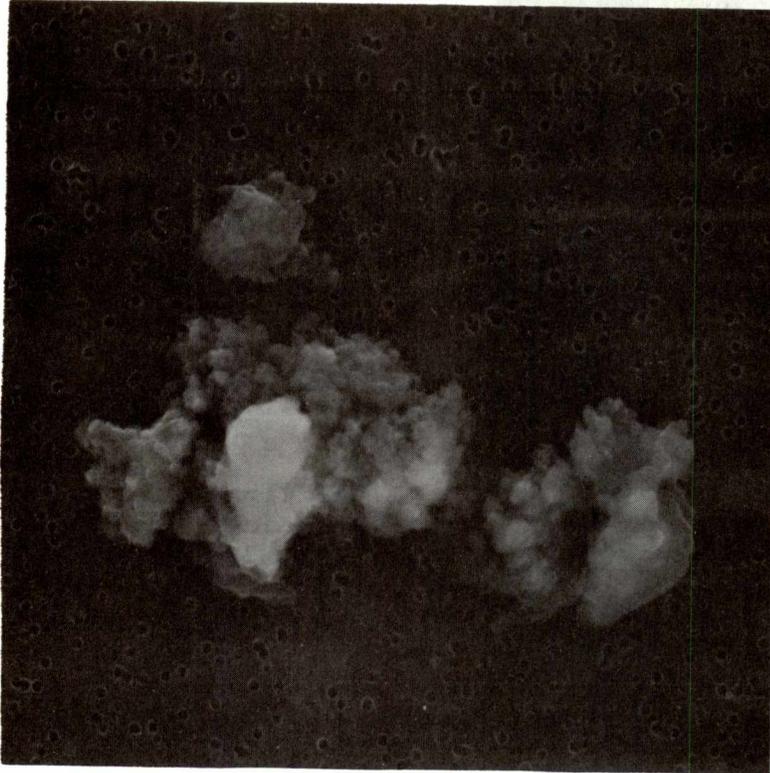


SIZE: 7
SHAPE: I
TRANS.: O
COLOR: Gold to Black
LUSTER: SM/D
TYPE: C
COMMENTS:

S-85-42871



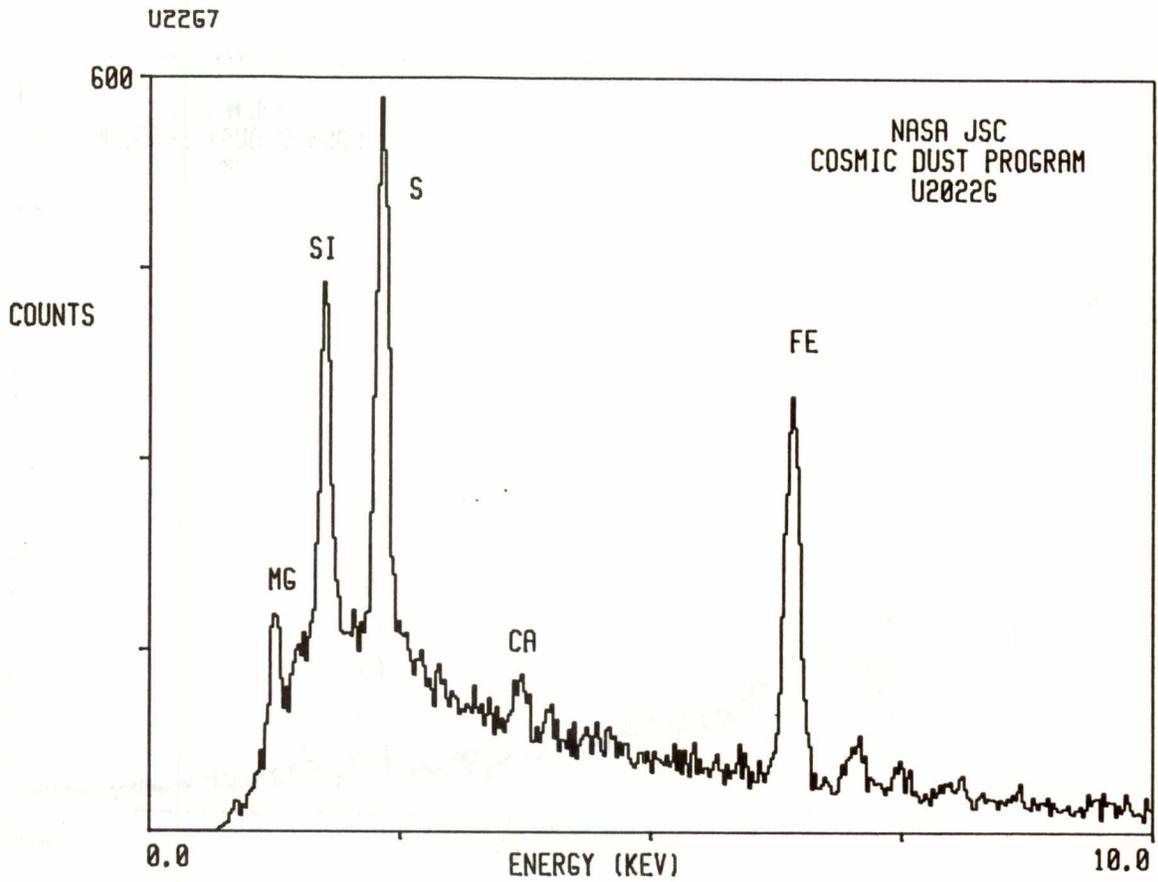
U2022 G 7



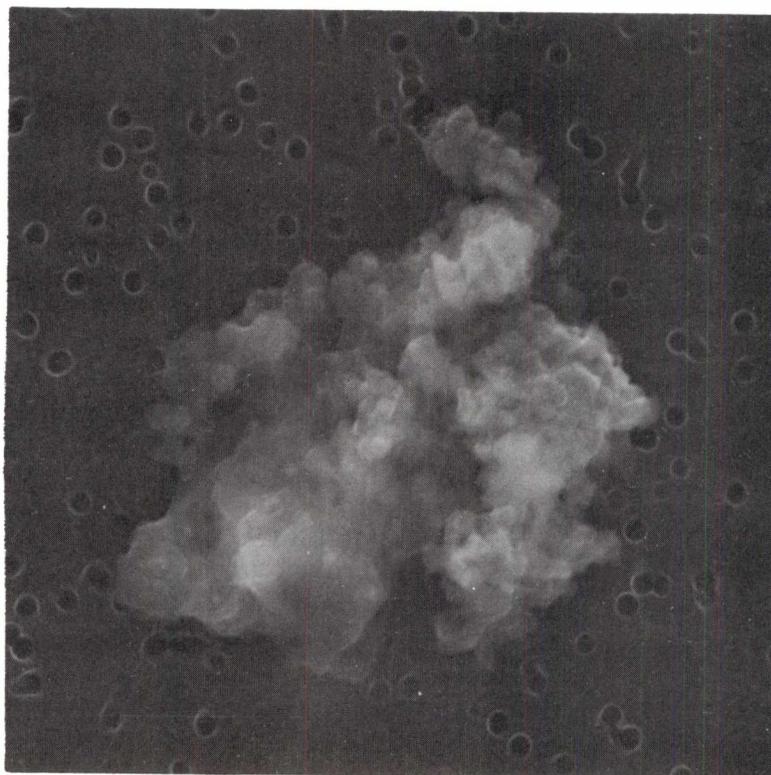
SIZE: 22x9
SHAPE: I
TRANS.: O
COLOR: Gold to Black
LUSTER: SM/D
TYPE: C

COMMENTS:
Broken grain,
related to
U2022G8, 9 and 24

S-85-42872

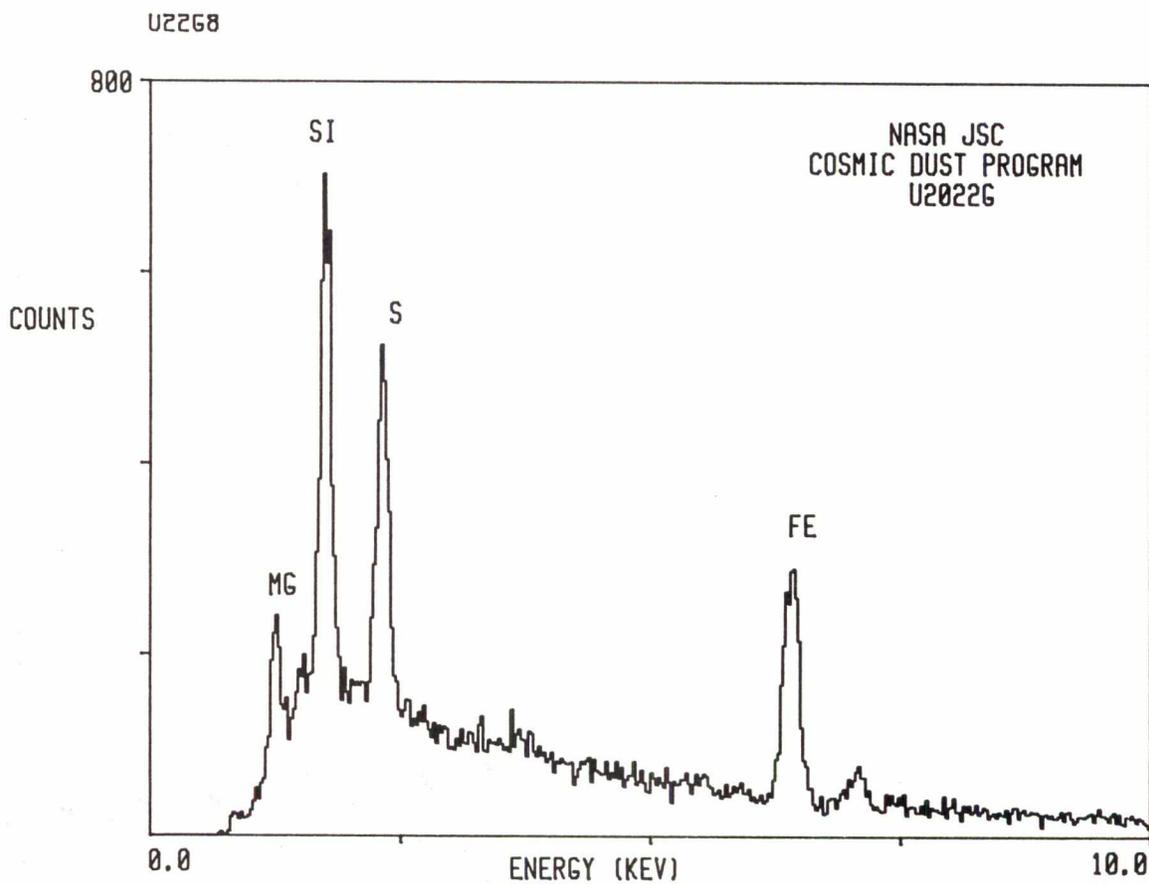


U2022 G 8

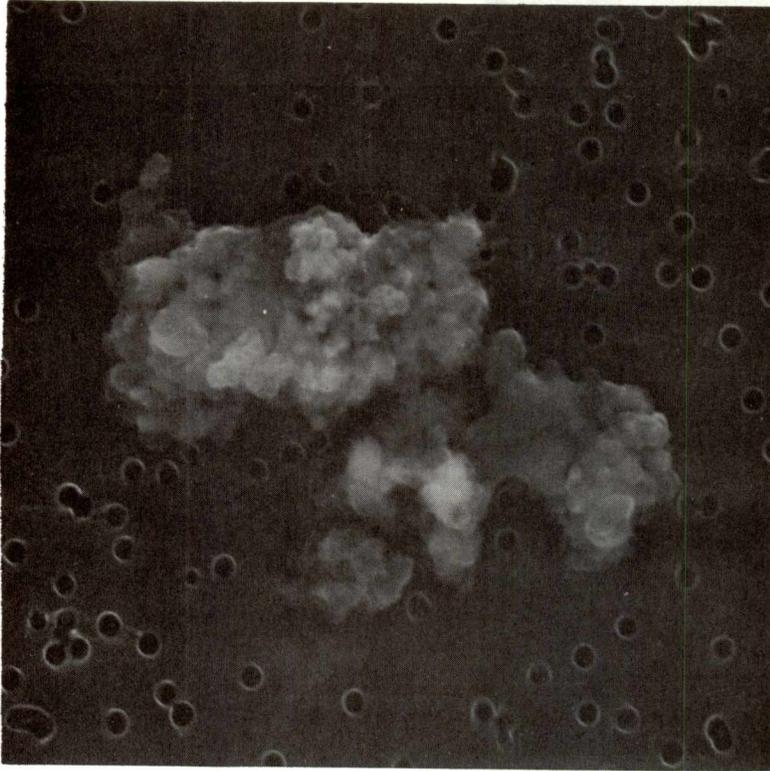


SIZE: 10
SHAPE: I
TRANS.: O
COLOR: Gold to Black
LUSTER: SM/D
TYPE: C
COMMENTS:
Related to
U2022G7, 9 and 24

S-85-42873



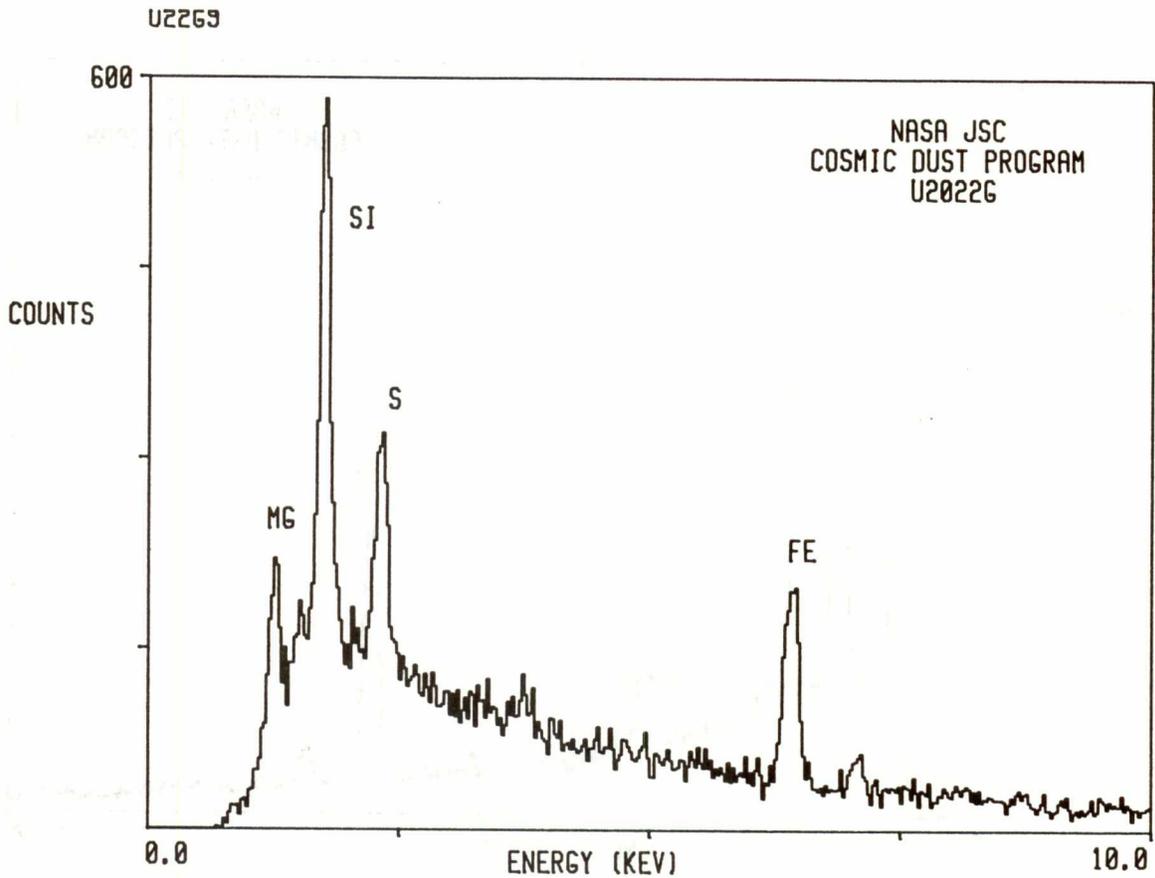
U2022 G 9



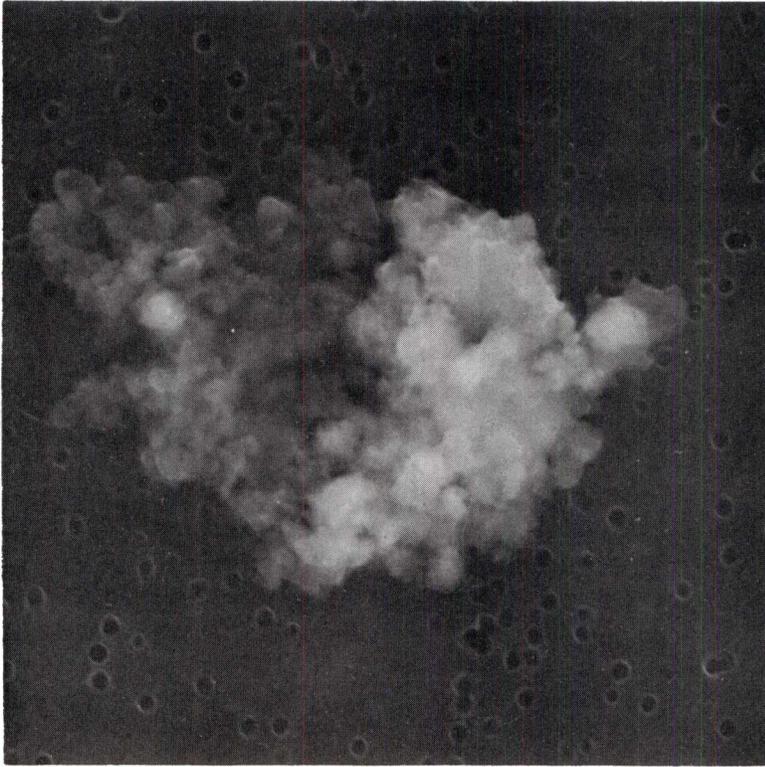
SIZE: 10x7
SHAPE: I
TRANS.: O
COLOR: Gold to Black
LUSTER: SM/D
TYPE: C

COMMENTS:
Related to
U2022G7, 8 and 24

S-85-42874

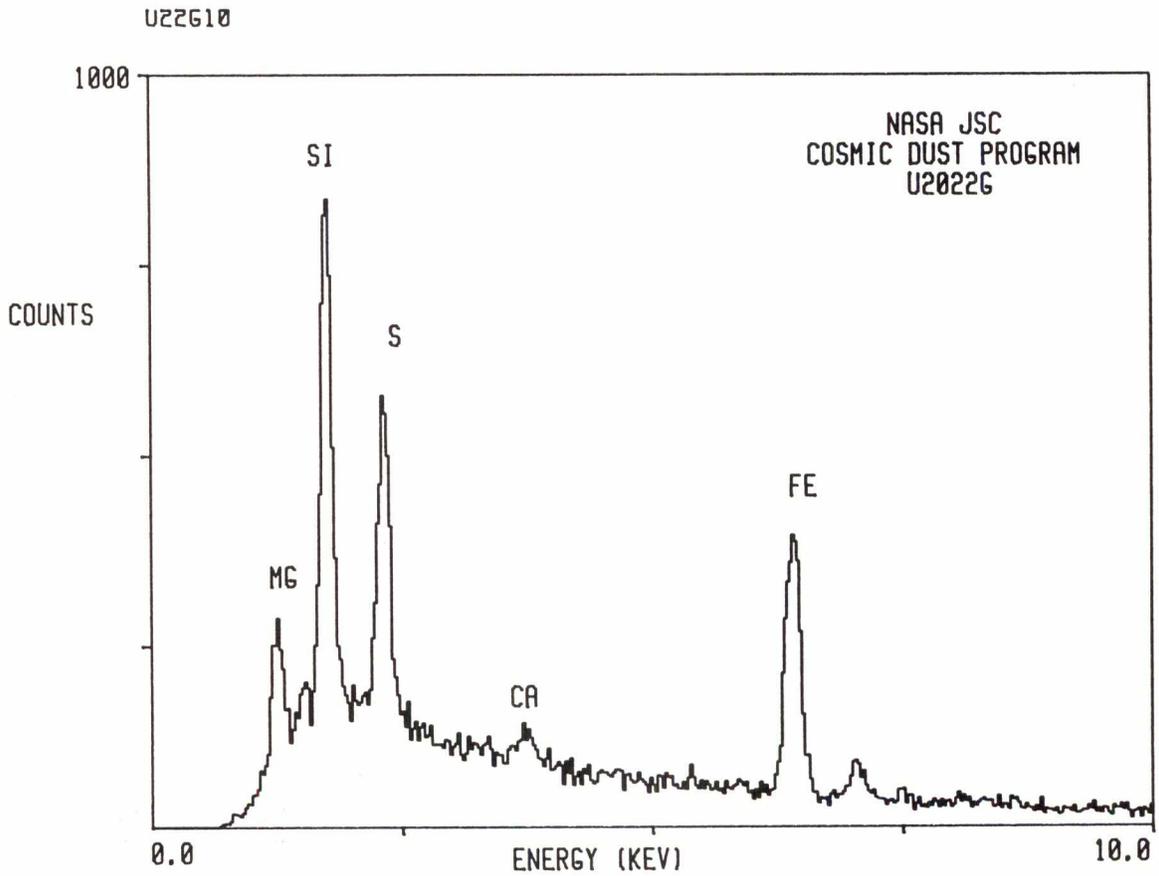


U2022 G 10



SIZE: 15x10
SHAPE: I
TRANS.: O
COLOR: Gold to Black
LUSTER: SM/D
TYPE: C
COMMENTS:

S-85-42875



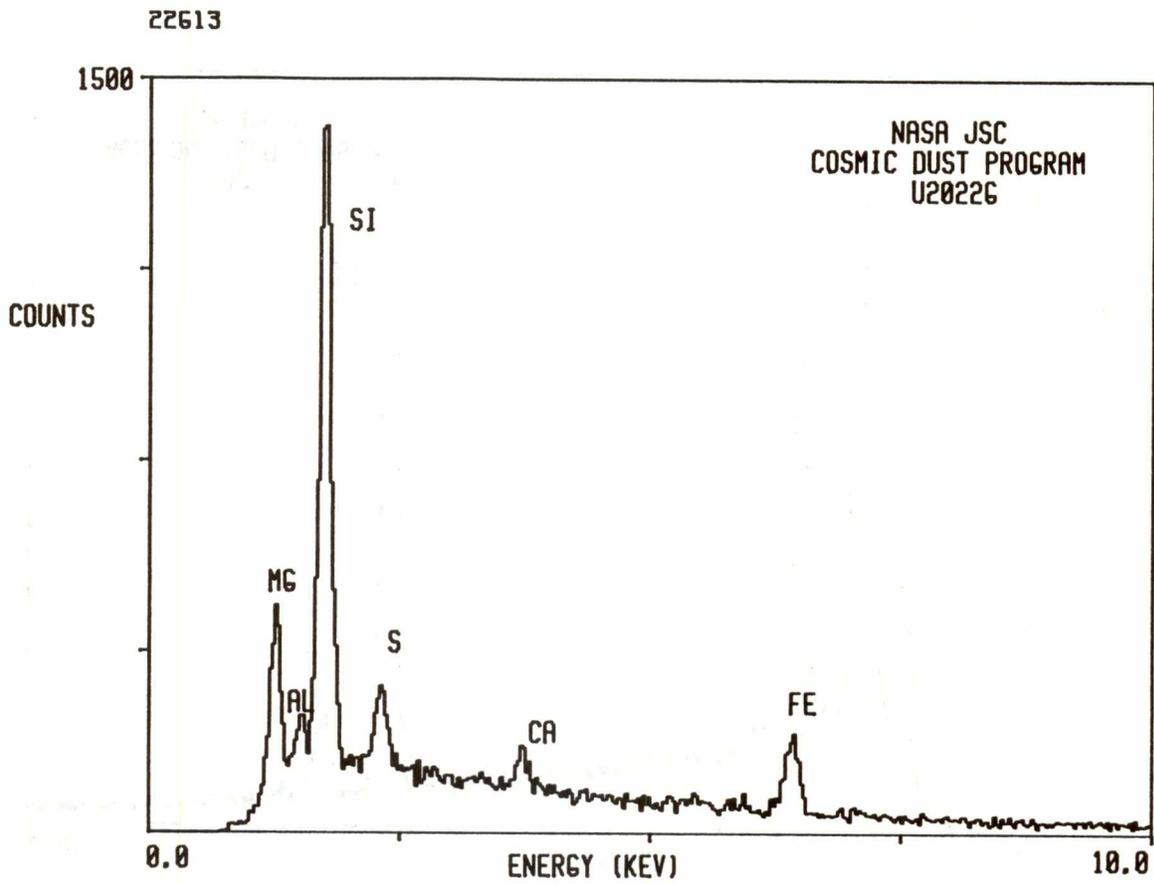
U2022 G 13



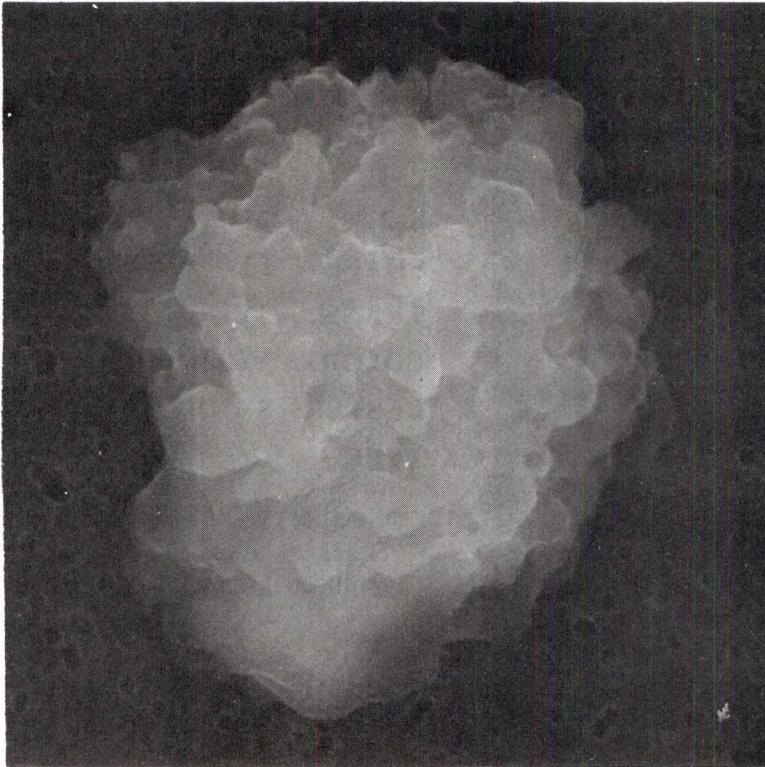
SIZE: 23x9
SHAPE: I
TRANS.: TL
COLOR: Yellow to Brown
LUSTER: SV/D
TYPE: C

COMMENTS:
Largest of 3
related grains

S-85-42883

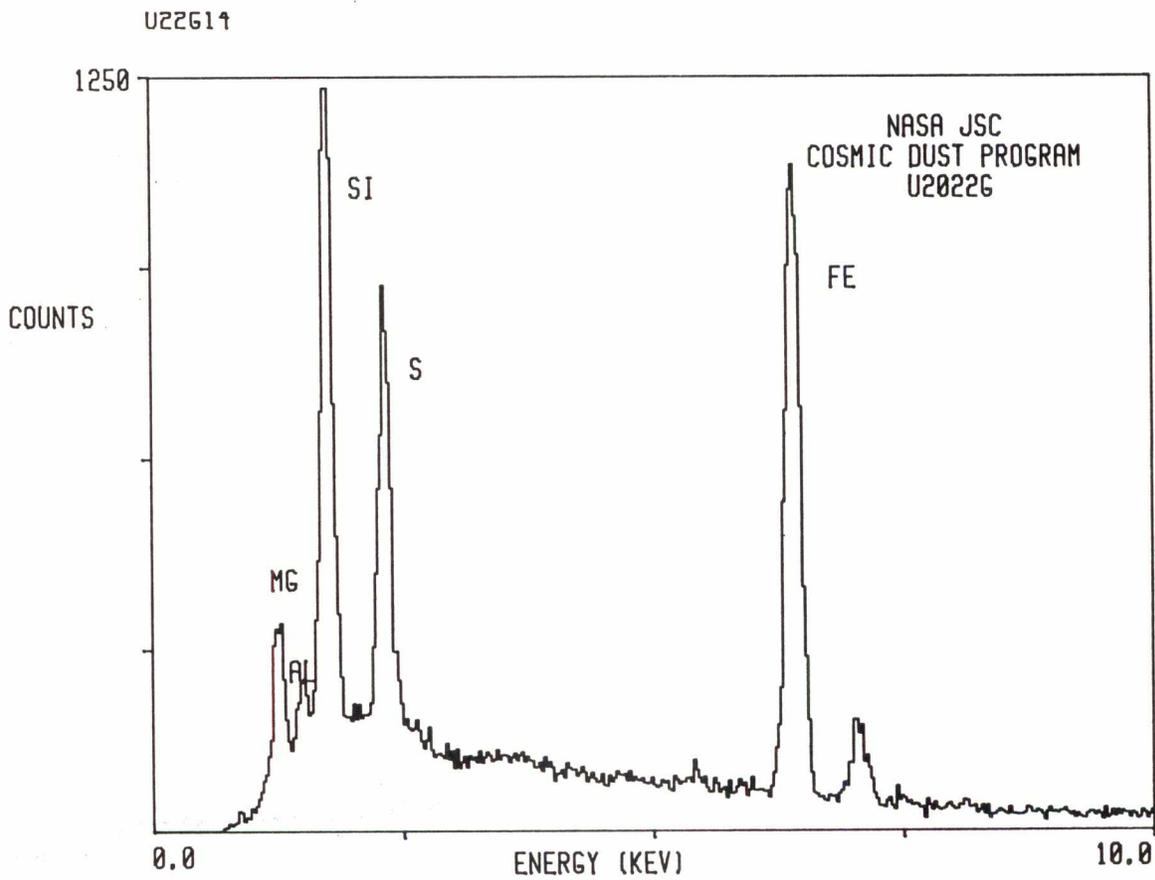


U2022 G 14

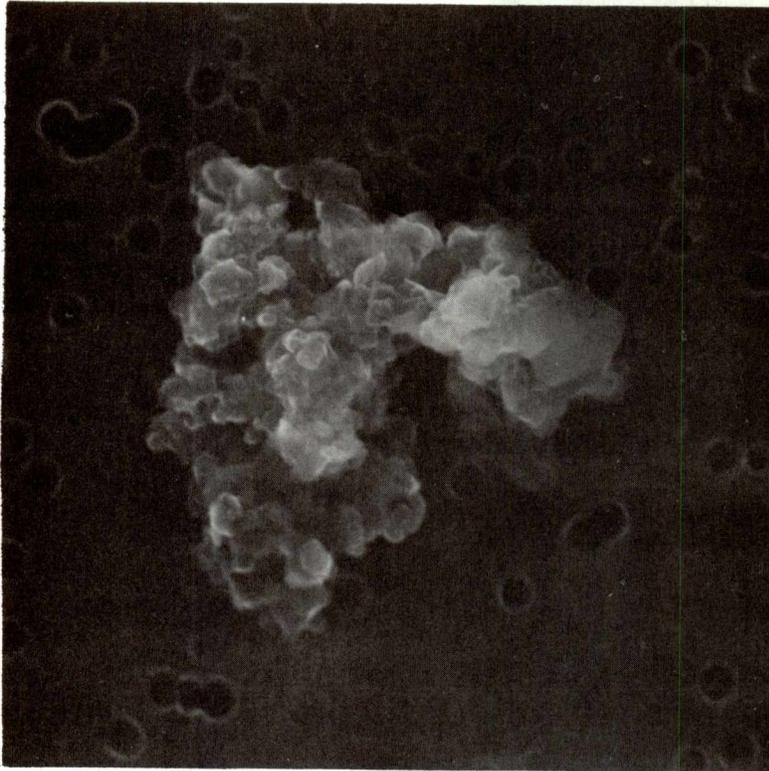


SIZE: 12
SHAPE: I
TRANS.: O
COLOR: Brown to Black
LUSTER: SV/D
TYPE: C
COMMENTS:

S-85-42884

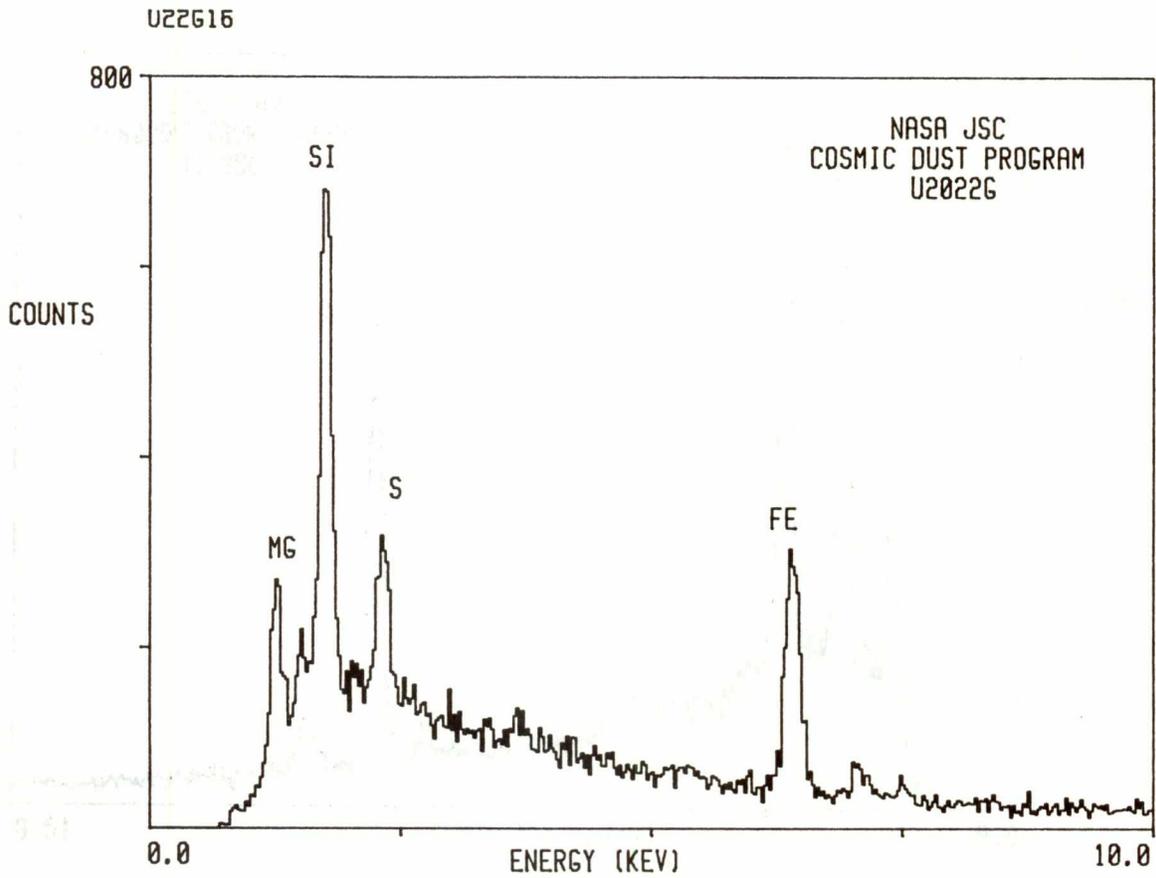


U2022 G 16

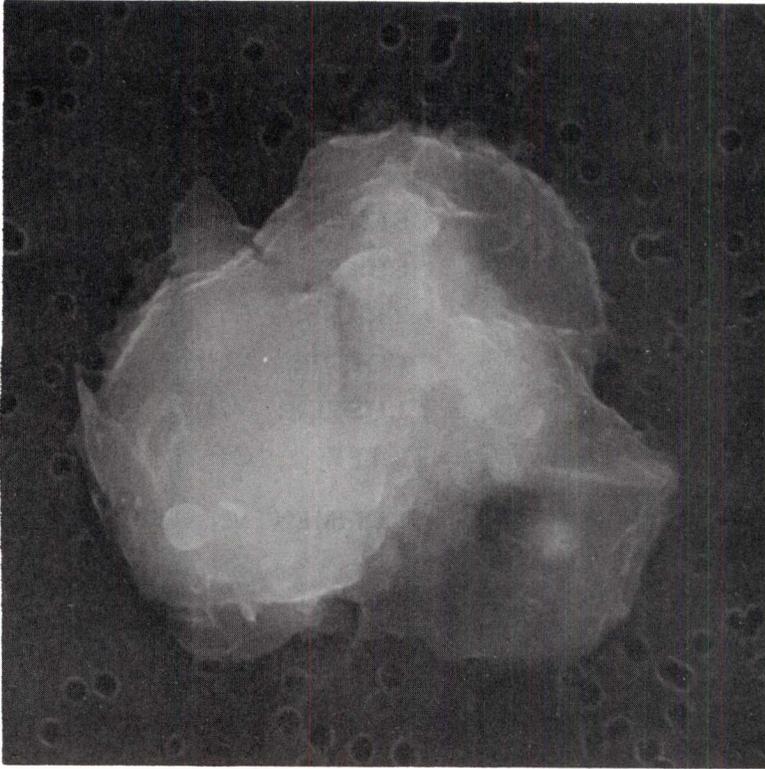


SIZE: 6
SHAPE: I
TRANS.: O
COLOR: Yellow to Brown
LUSTER: V/D
TYPE: C
COMMENTS:

S-85-42886



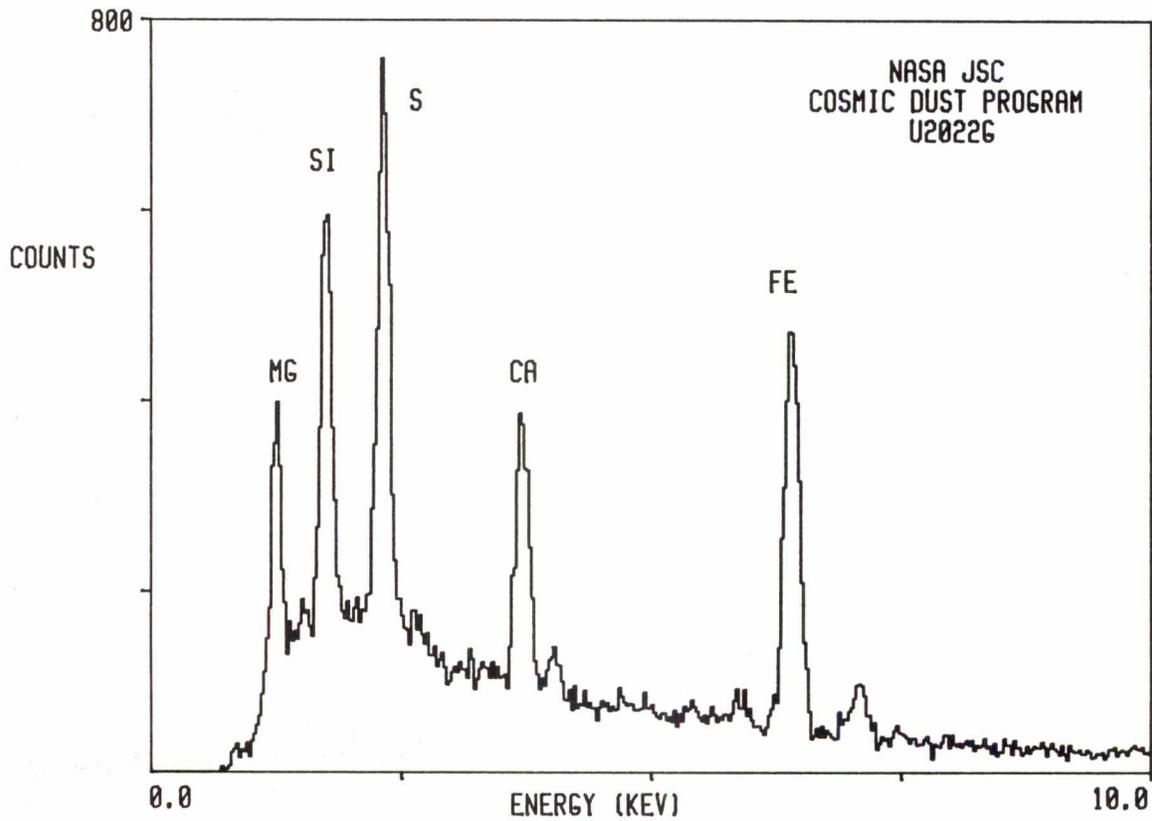
U2022 G 17



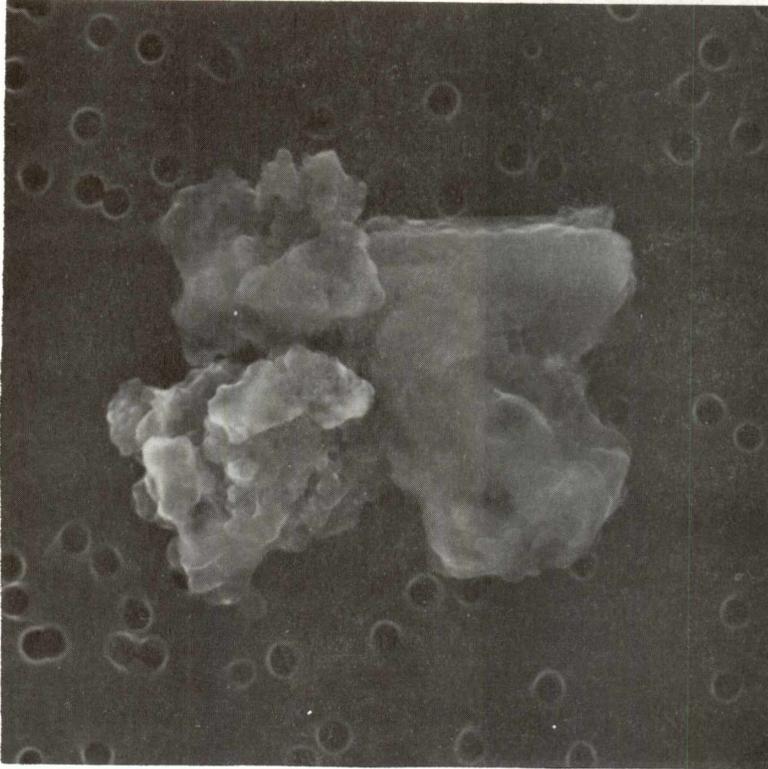
SIZE: 12
SHAPE: I
TRANS.: T/O
COLOR: Yellow to Brown
LUSTER: V/D
TYPE: C
COMMENTS:

S-85-42887

U22617



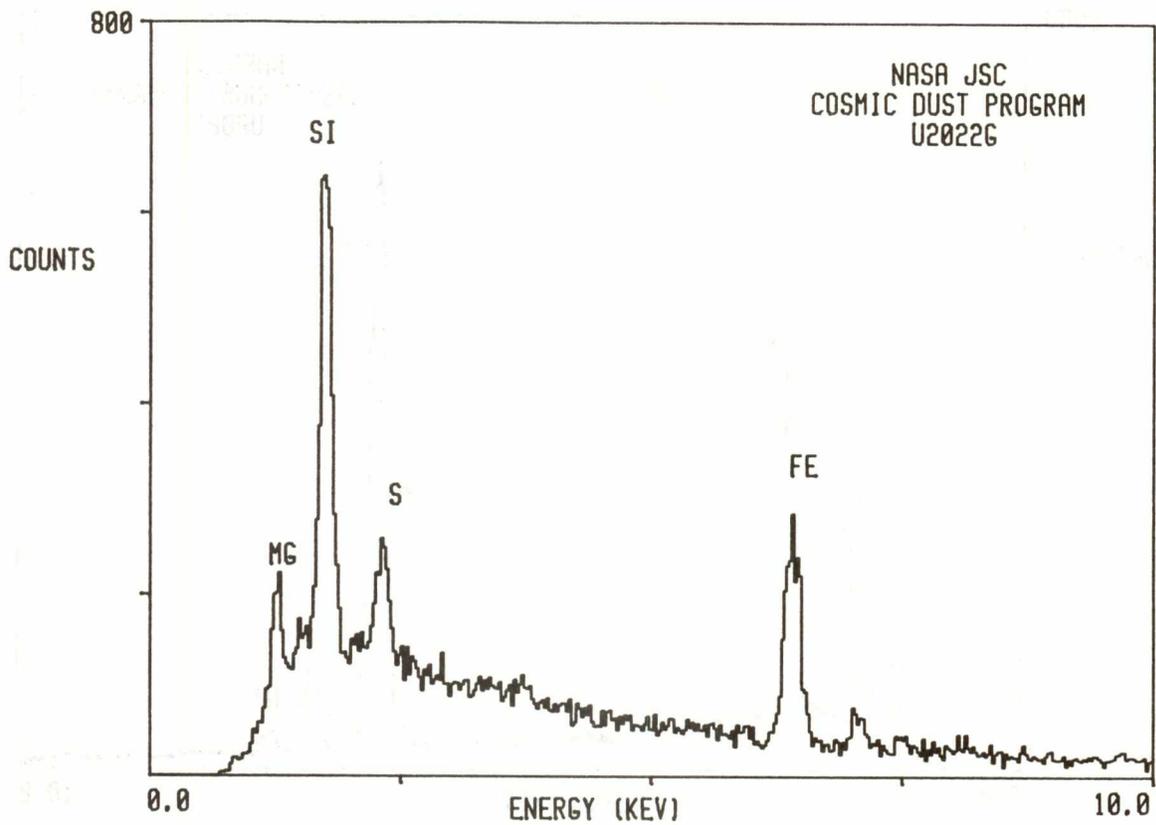
U2022 G 18



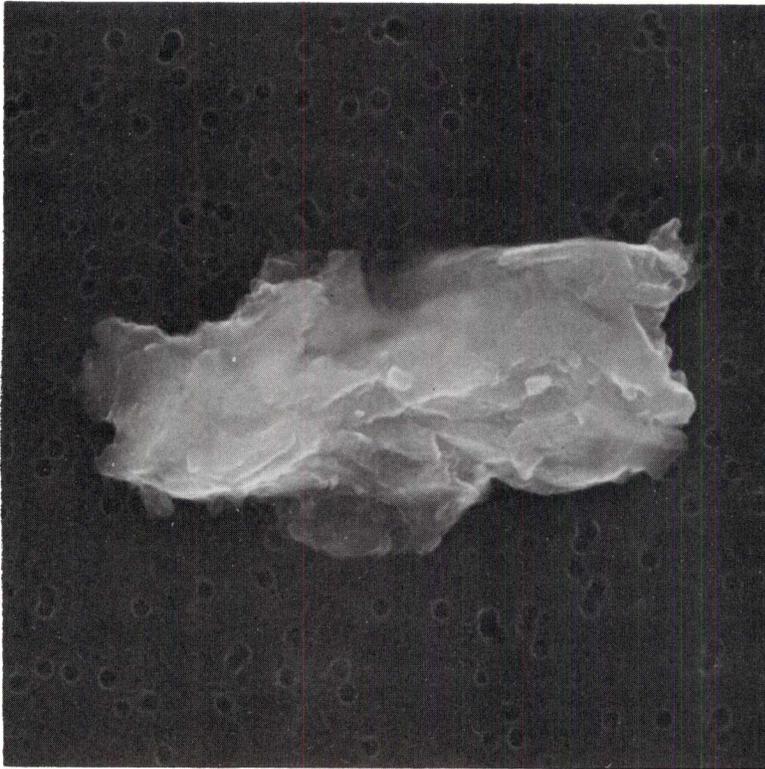
SIZE: 25x18
SHAPE: I
TRANS.: T/O
COLOR: Yellow, Orange to Brown
LUSTER: V/D
TYPE: C
COMMENTS:

S-85-42888

U22618

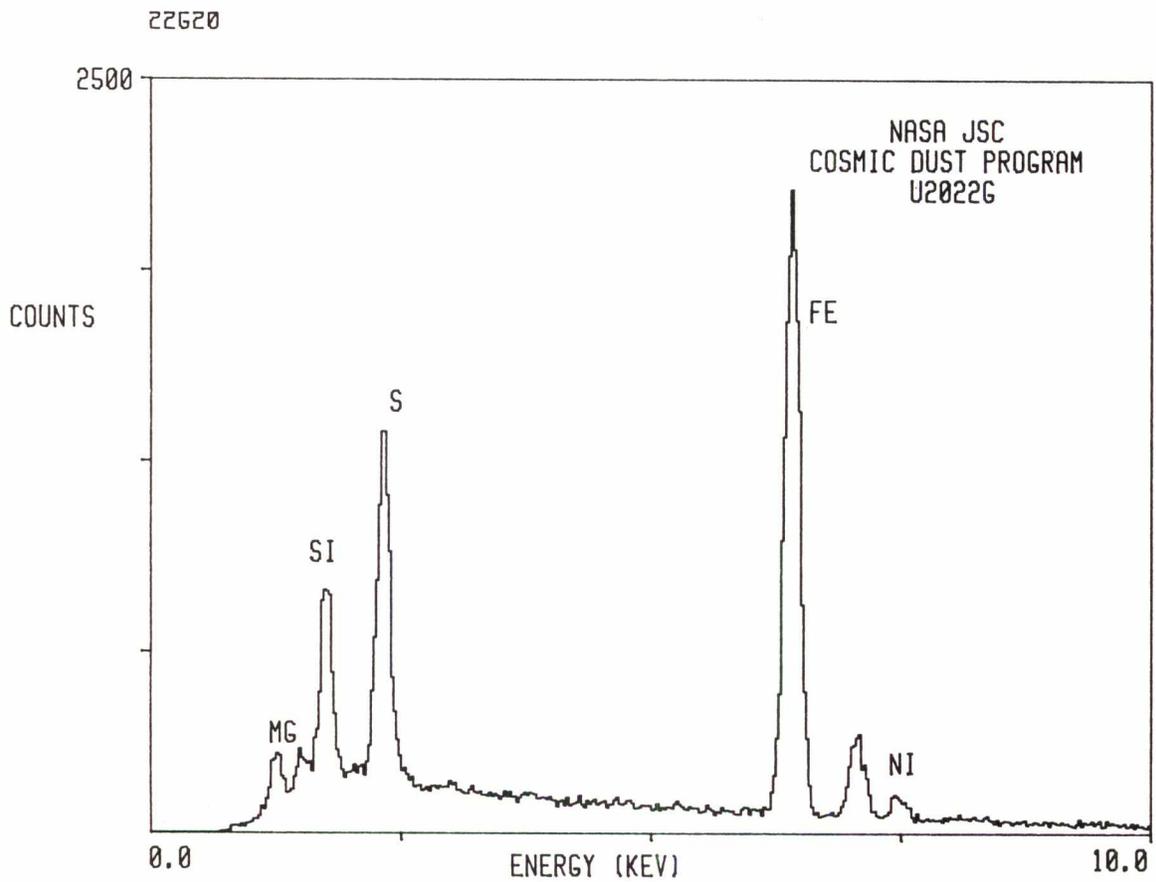


U2022 G 20

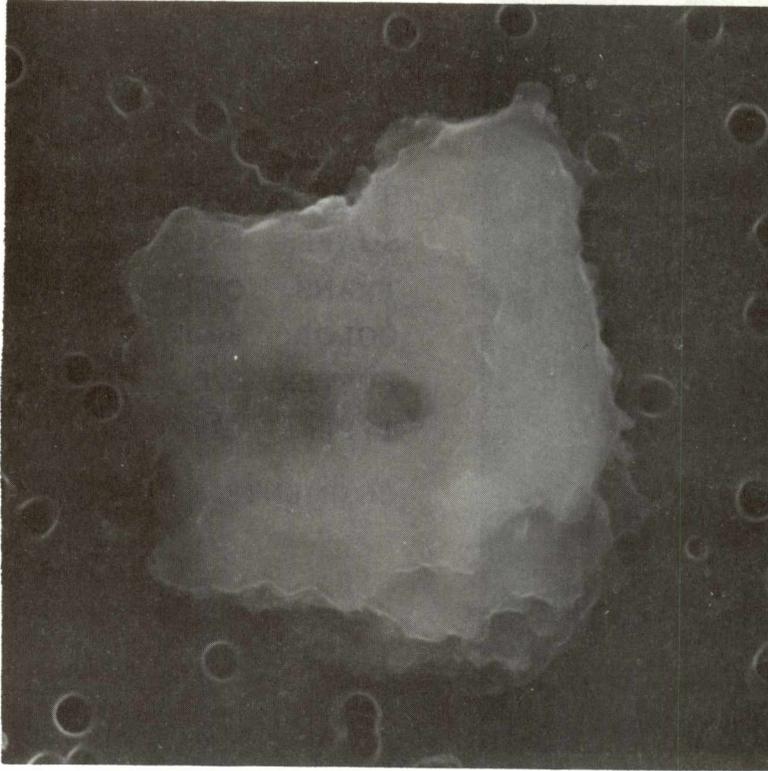


SIZE: 12x5
SHAPE: I
TRANS.: O
COLOR: Gold to Brown
LUSTER: SM/D
TYPE: C?
COMMENTS:

S-85-42890

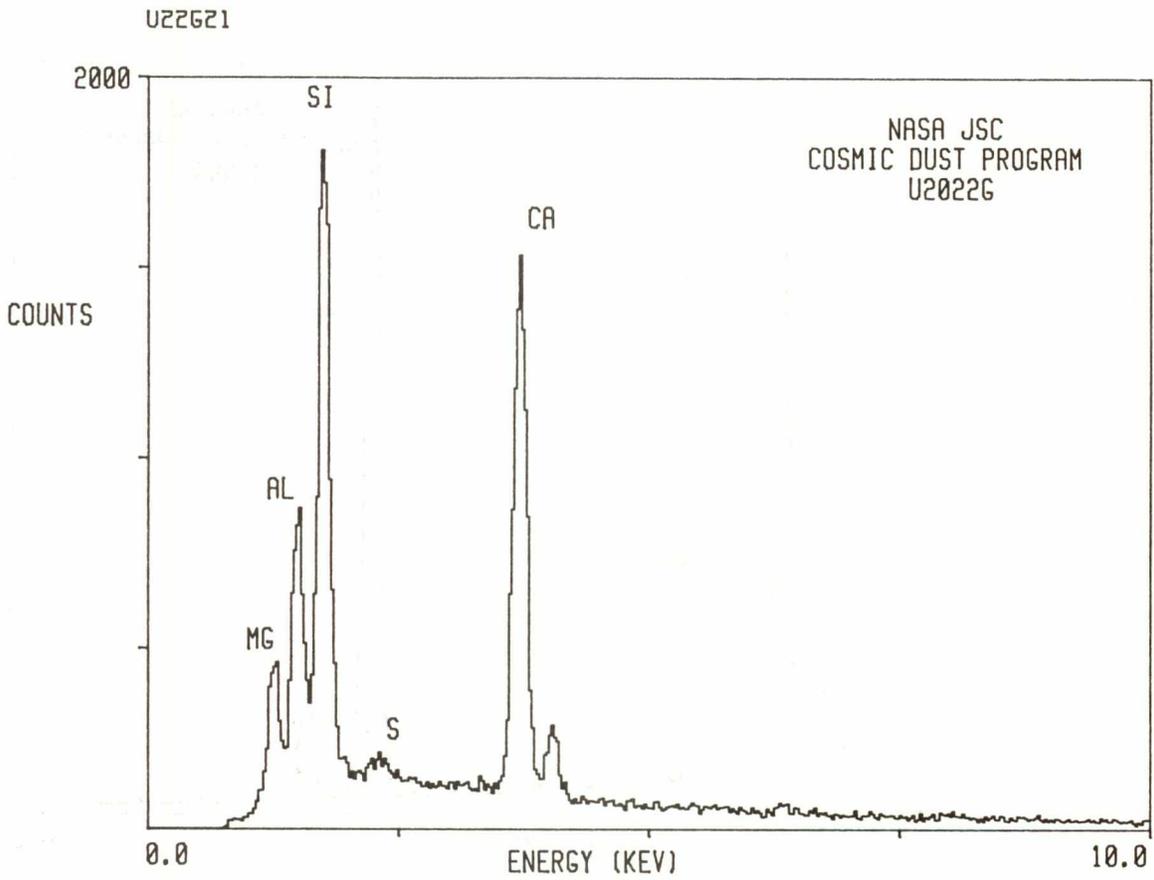


U2022 G 21

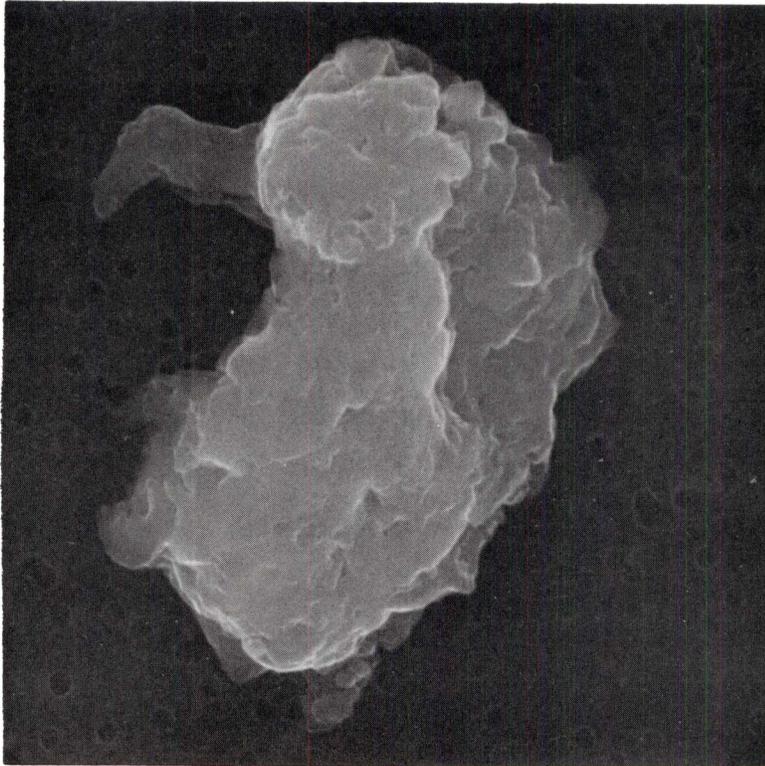


SIZE: 7
SHAPE: I
TRANS.: TL
COLOR: White
LUSTER: SV
TYPE: C?
COMMENTS:

S-85-42891

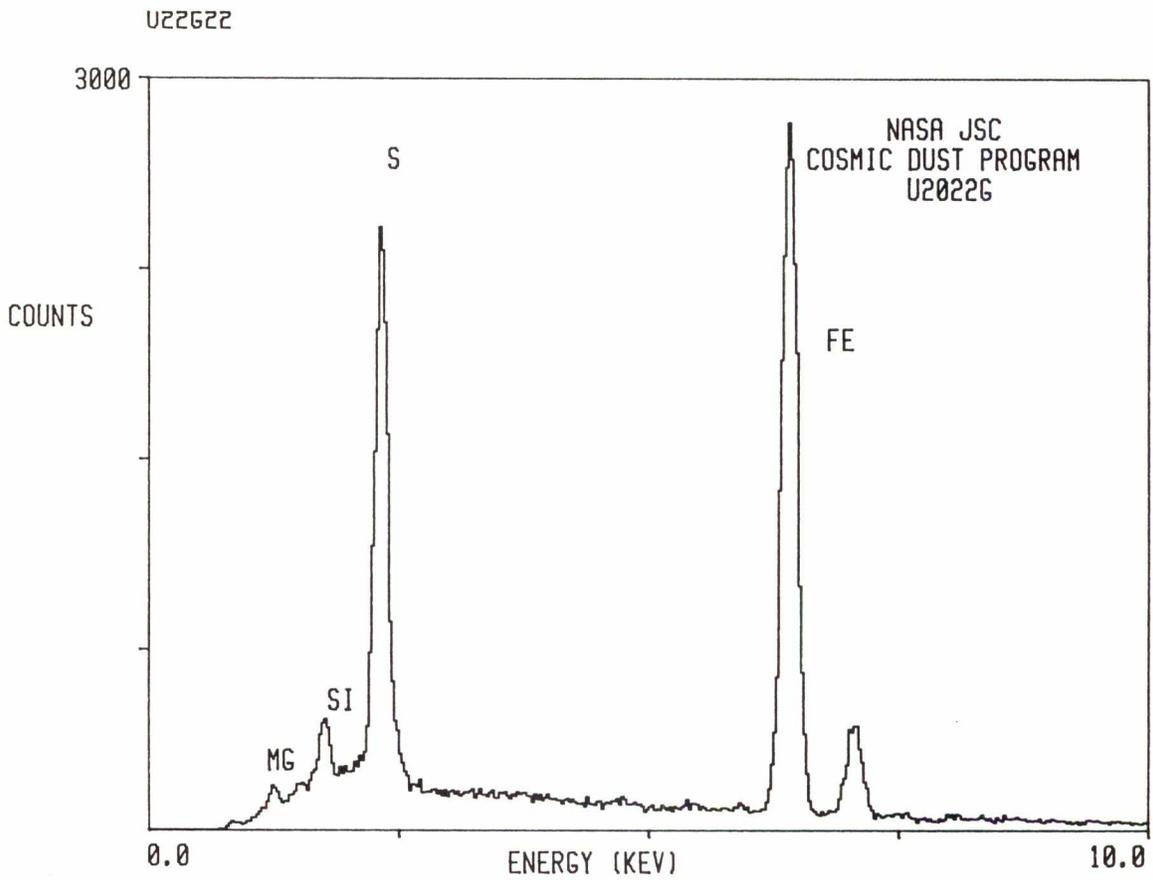


U2022 G 22

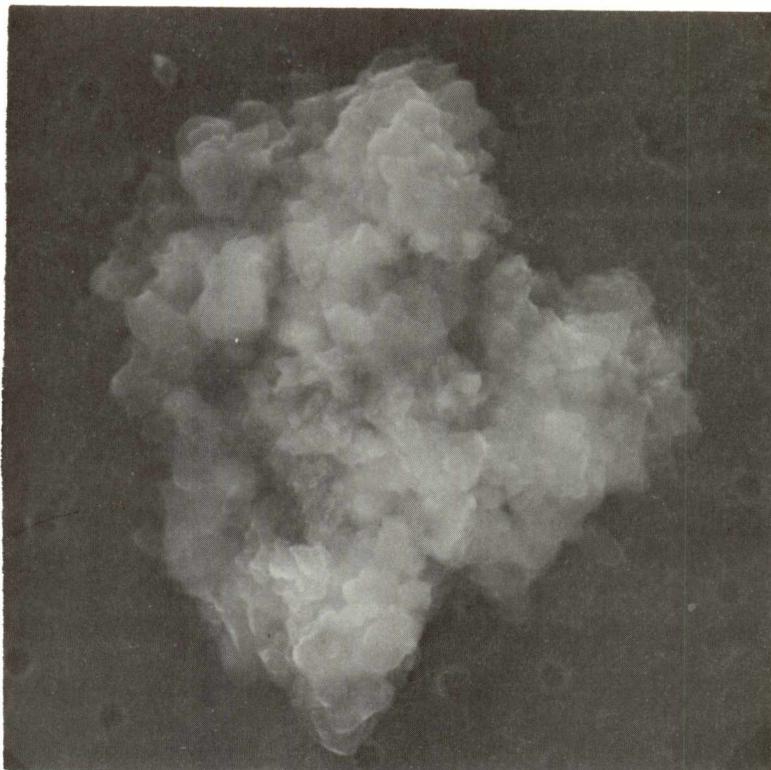


SIZE: 10x9
SHAPE: I
TRANS.: O
COLOR: Black
LUSTER: P/D
TYPE: C?
COMMENTS:

S-85-42892

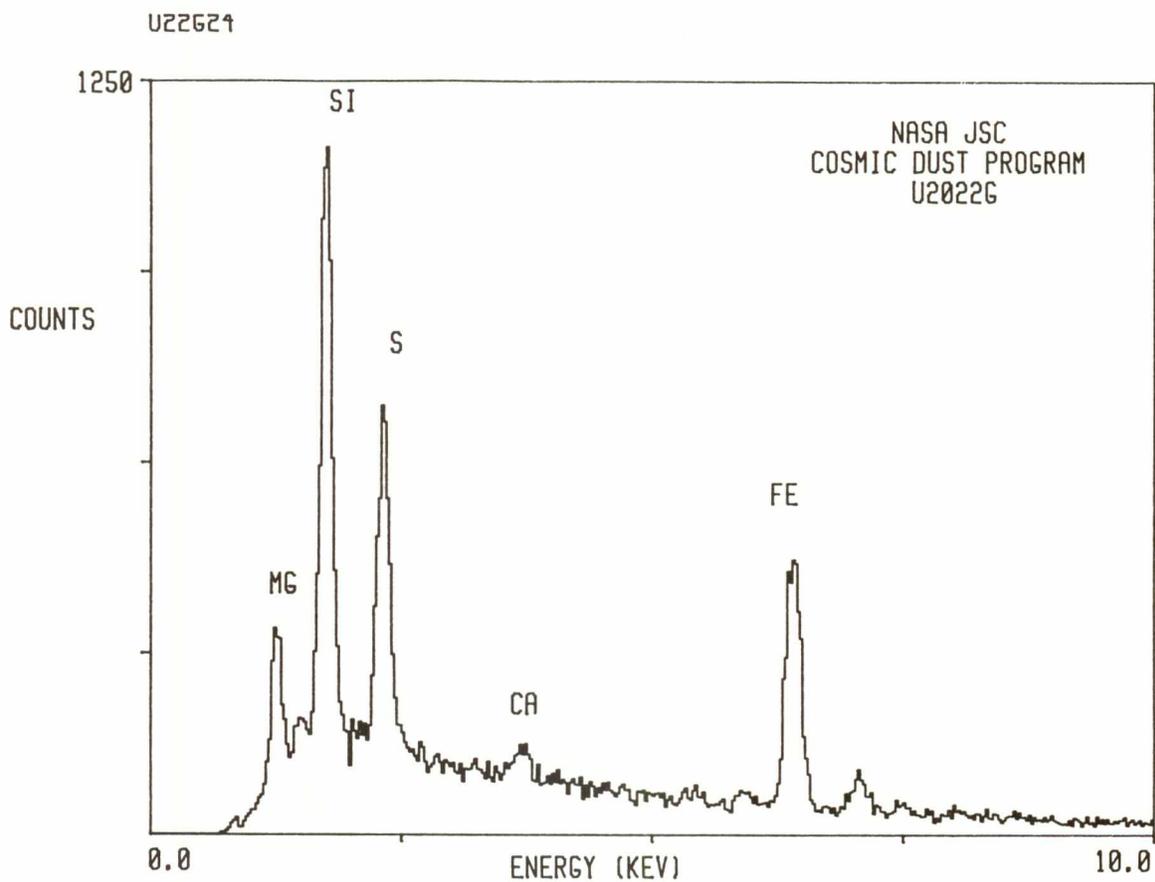


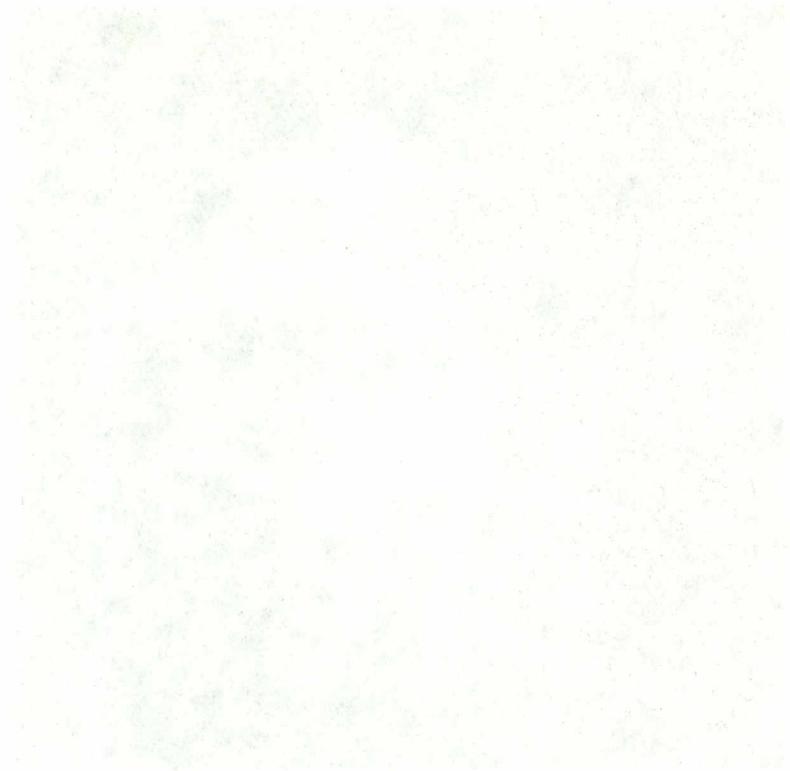
U2022 G 24



SIZE: 7
SHAPE: I
TRANS.: O
COLOR: Gold to Black
LUSTER: SM/D
TYPE: C
COMMENTS:
Related to
U2022G7, 8 and 9

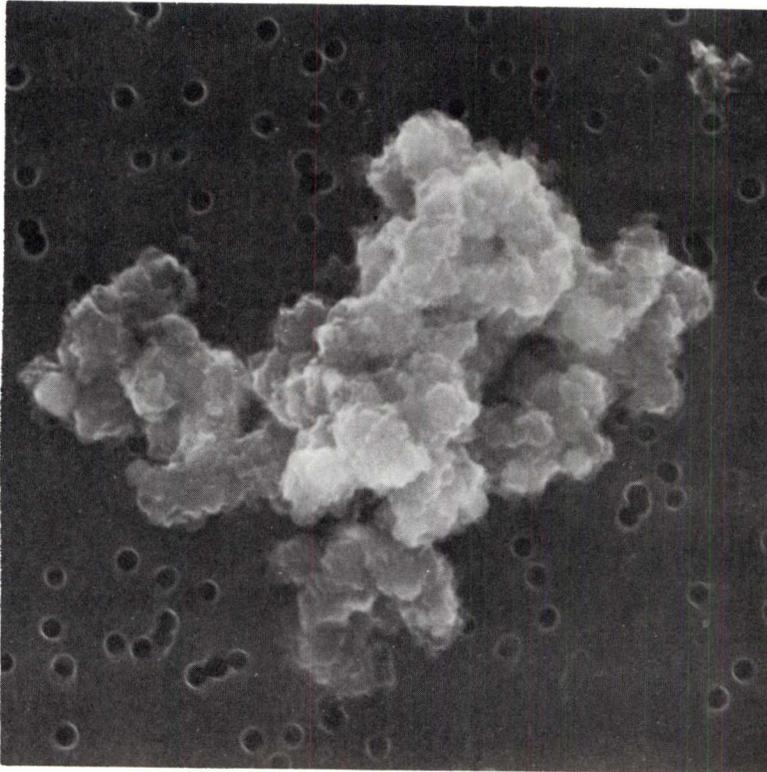
S-85-42893





UNCERTAIN

U2022 B 17

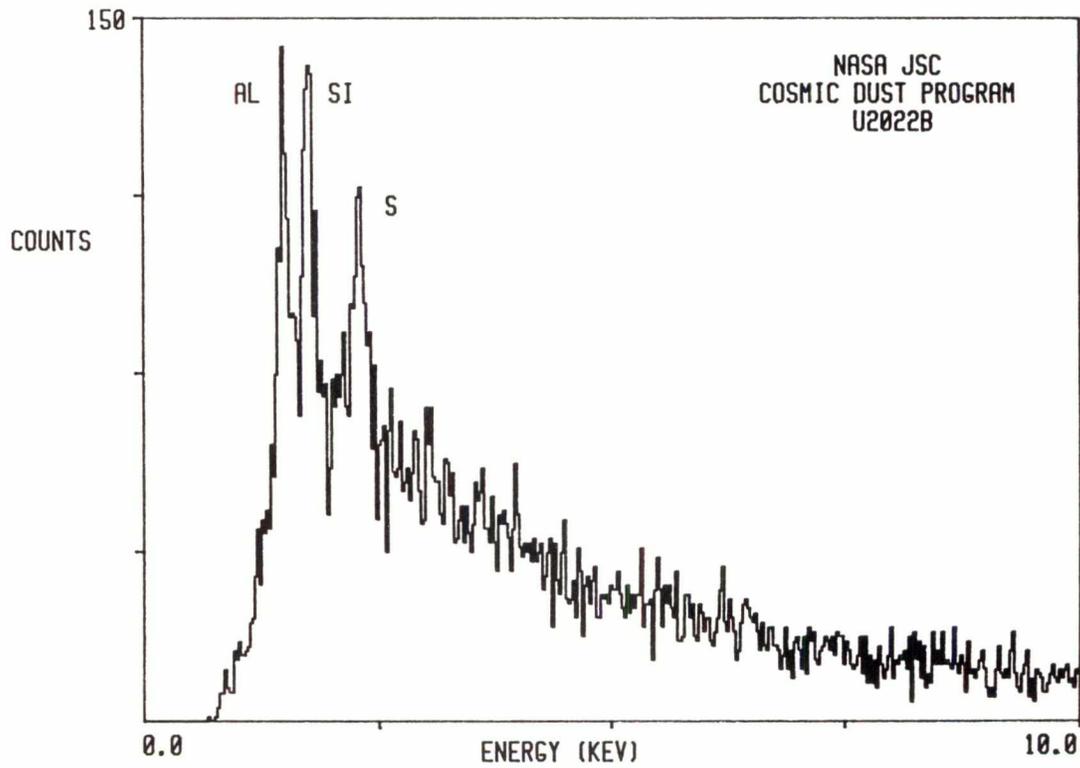


SIZE: 10x8
SHAPE: I
TRANS.: O
COLOR: Black
LUSTER: D
TYPE: ?

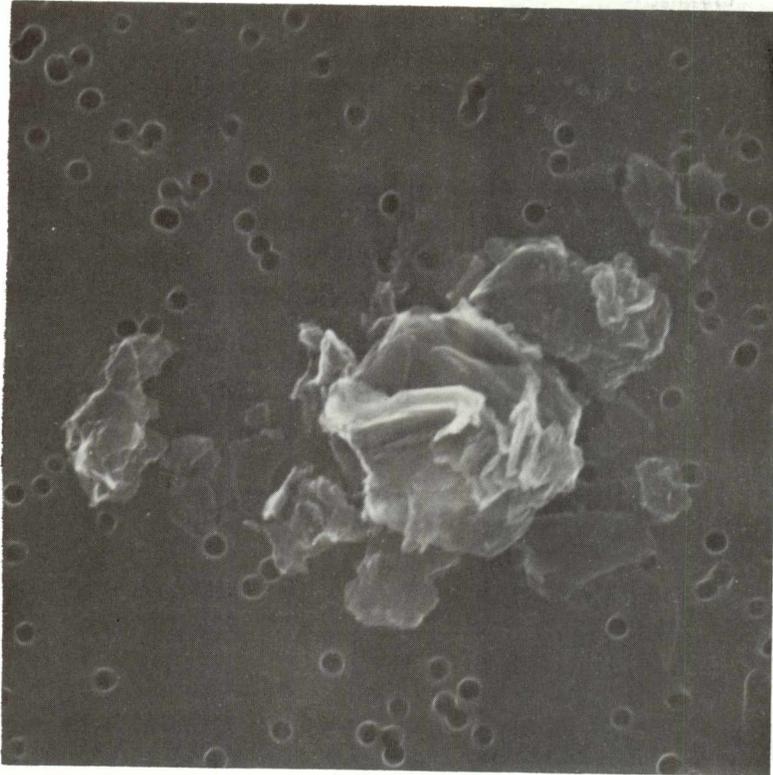
COMMENTS:
May be related to
U2022B16

S-85-42779

U22B17



U2022 C 11

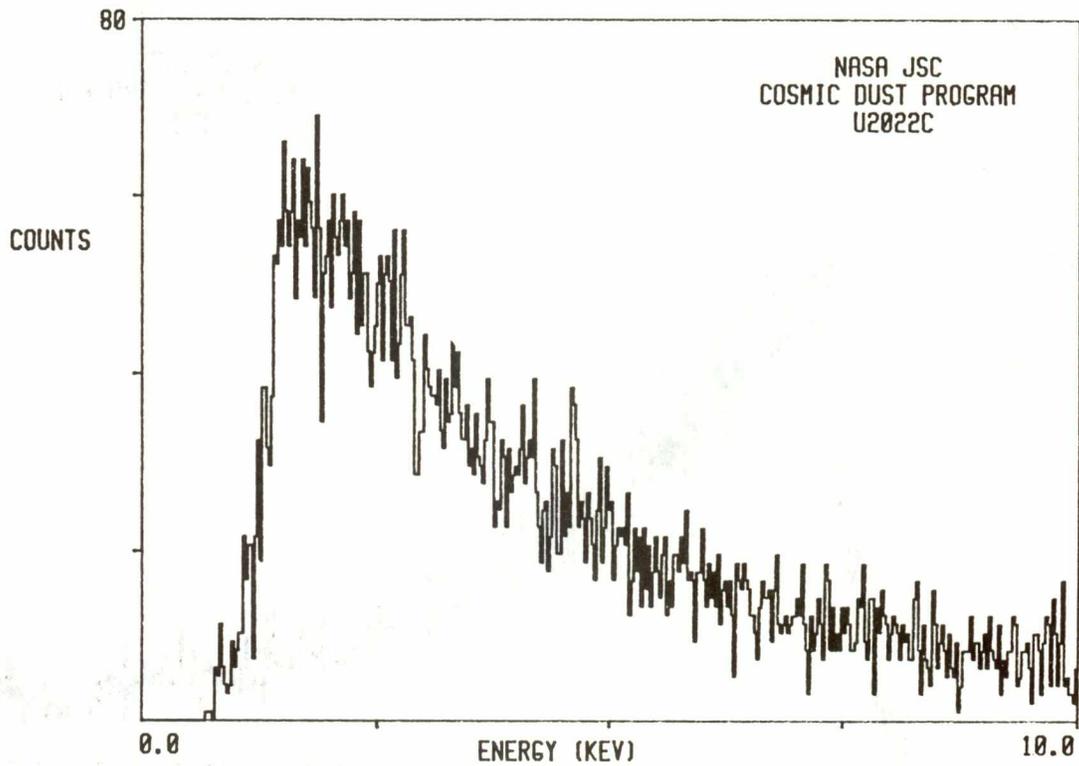


SIZE: 7
SHAPE: I
TRANS.: O
COLOR: Brown to Black
LUSTER: D
TYPE: ?

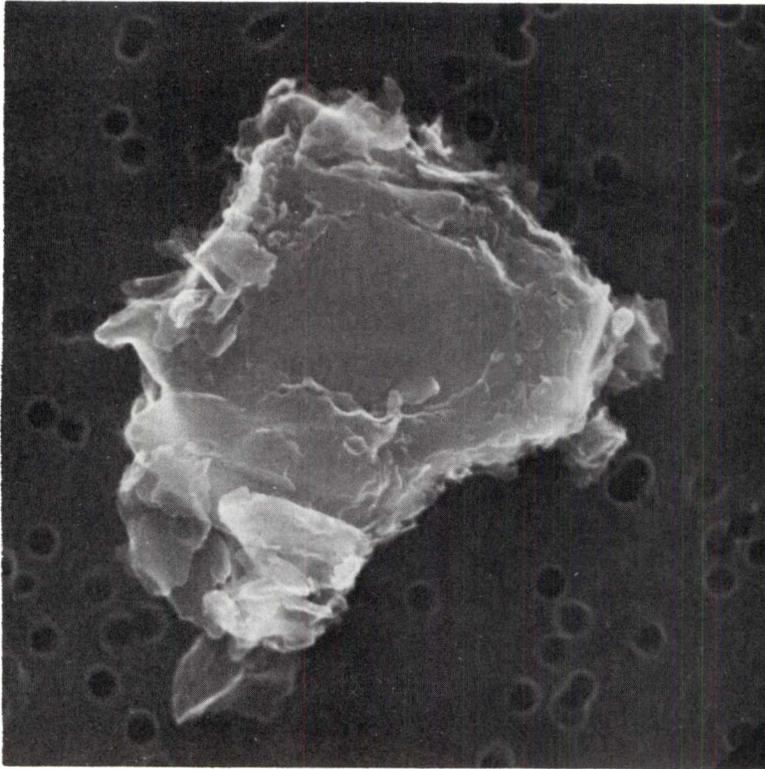
COMMENTS:
May be related to
U2022C12

S-85-42793

U22C11

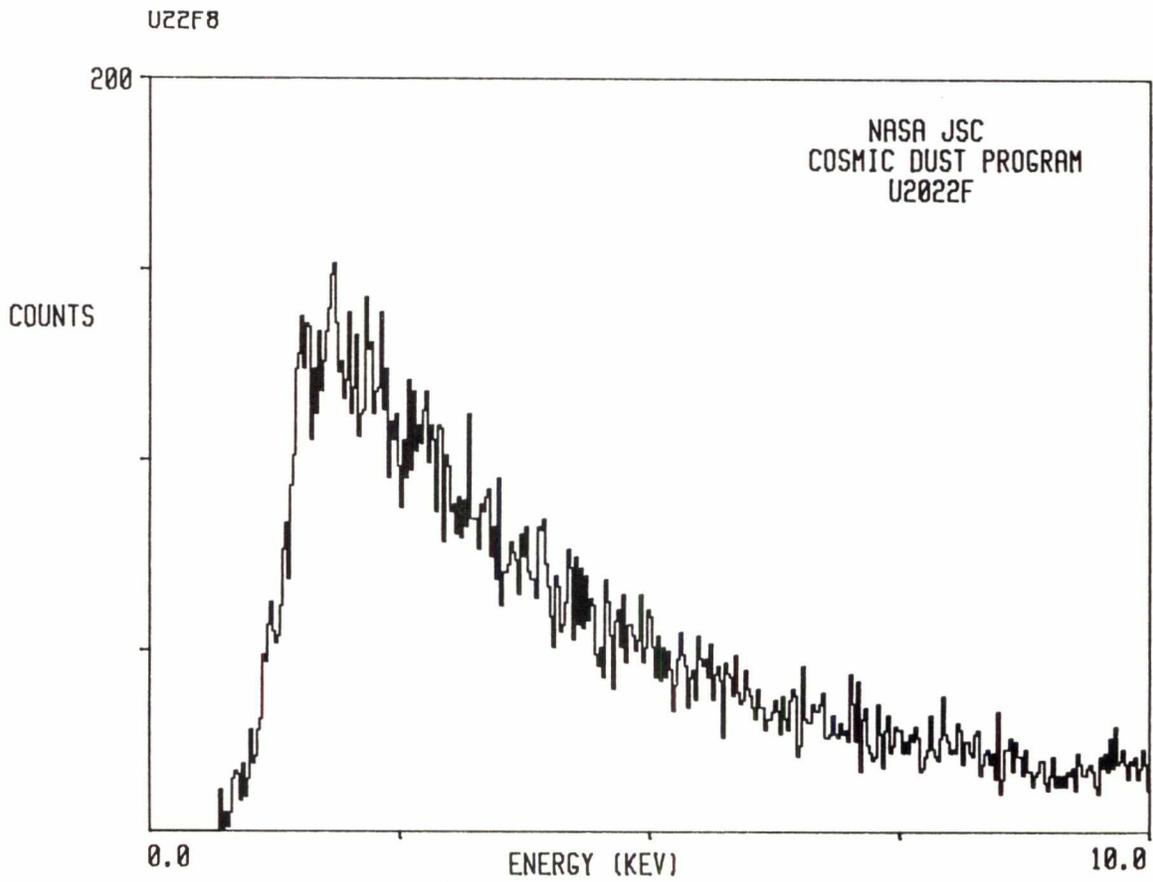


U2022 F 8

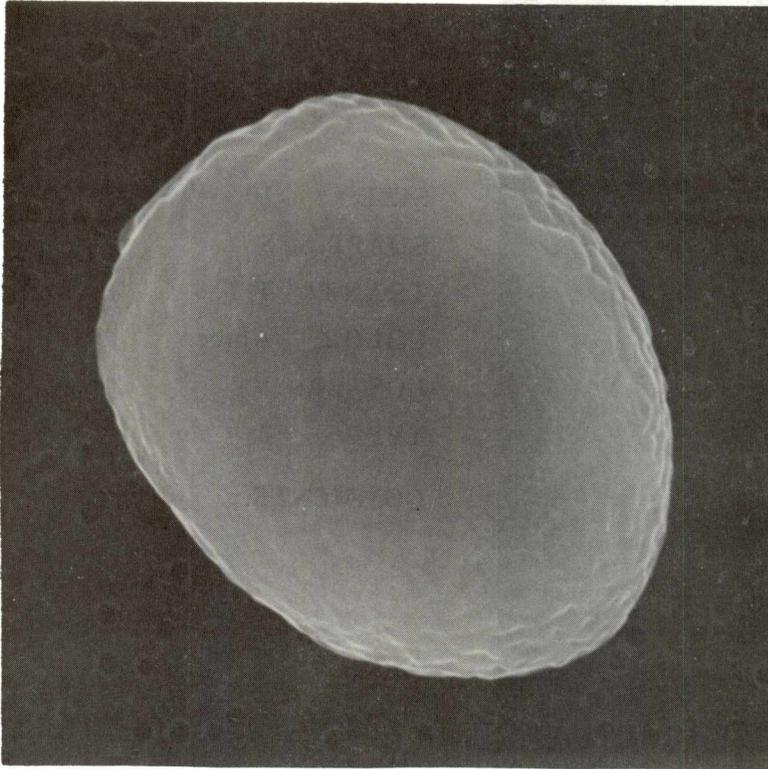


SIZE: 8
SHAPE: I
TRANS.: O
COLOR: Gold
LUSTER: SM
TYPE: ?
COMMENTS:

S-85-42854

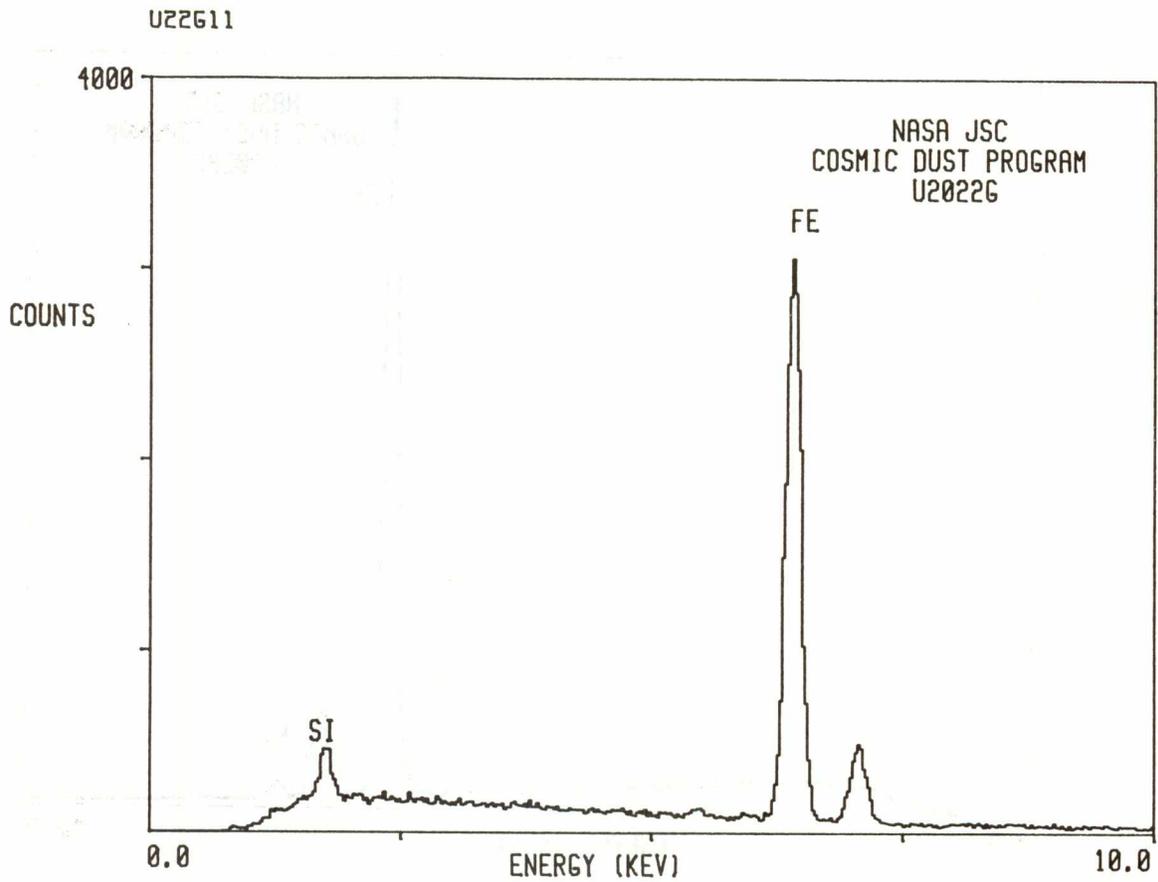


U2022 G 11

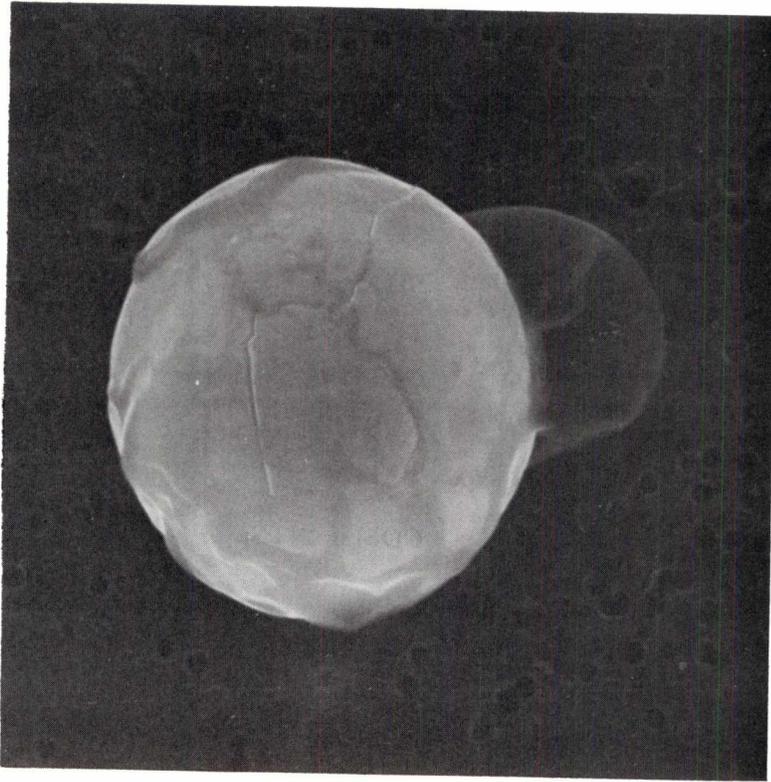


SIZE: 11
SHAPE: S
TRANS.: T
COLOR: Amber
LUSTER: V
TYPE: ?
COMMENTS:

S-85-42881

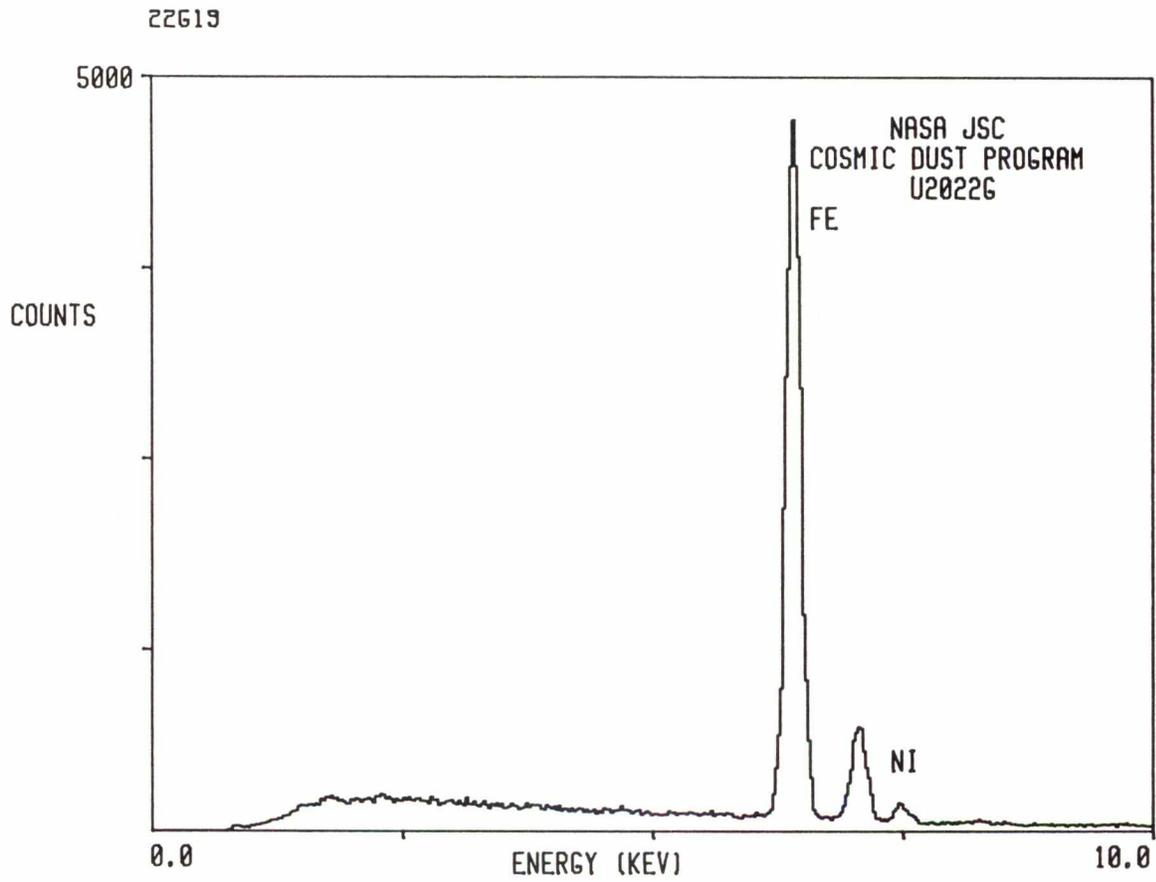


U2022 G 19

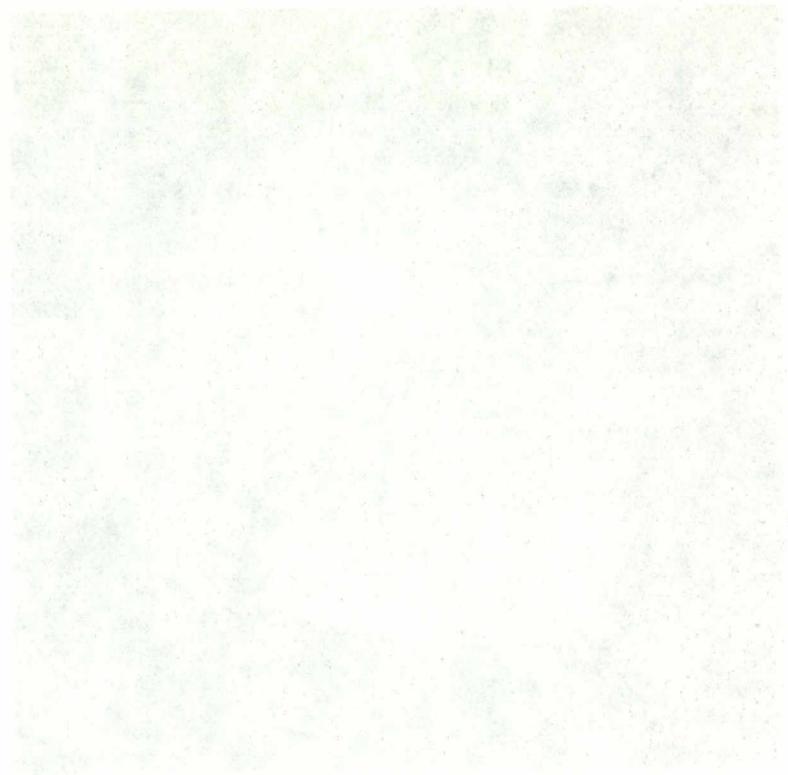


SIZE: 10
SHAPE: S
TRANS.: T
COLOR: Amber
LUSTER: V
TYPE: ?
COMMENTS:

S-85-42889



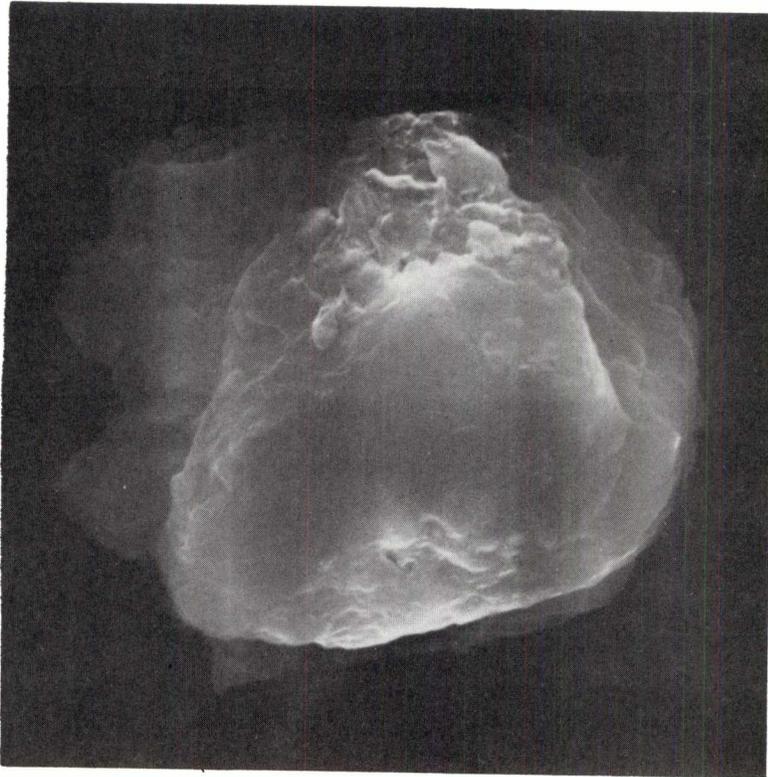
E. S. 2008



TERRESTRIAL CONTAMINATION

2008
MARCH 2008
25/8/08

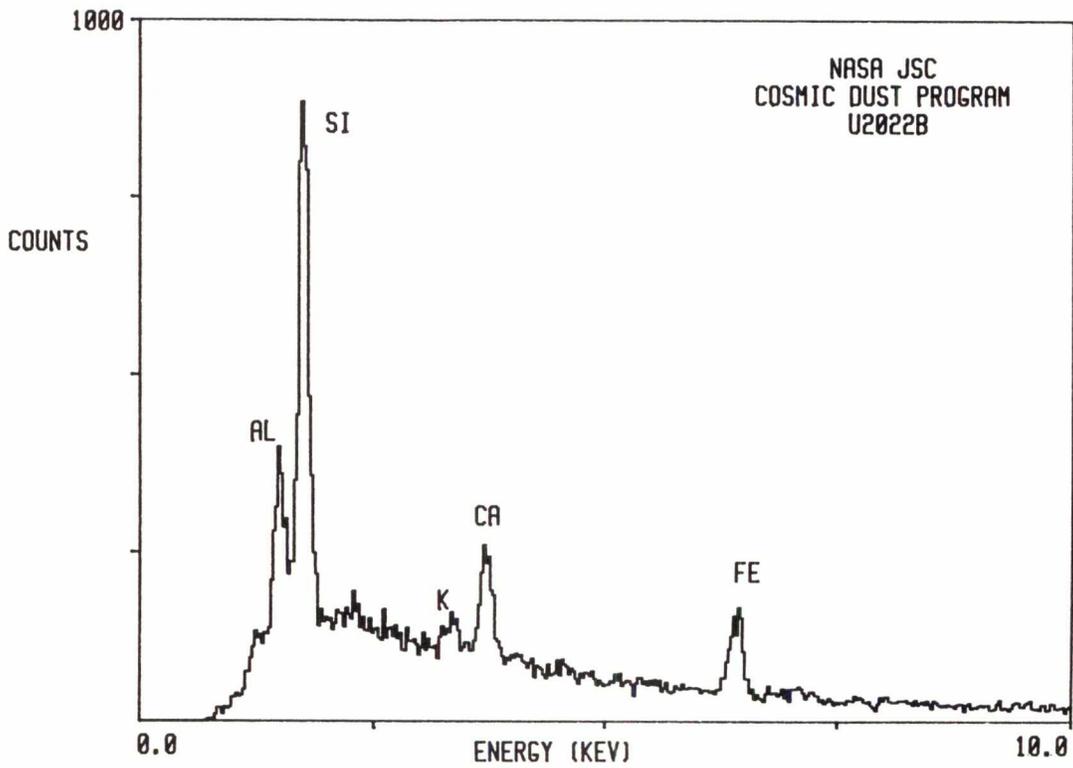
U2022 B 3



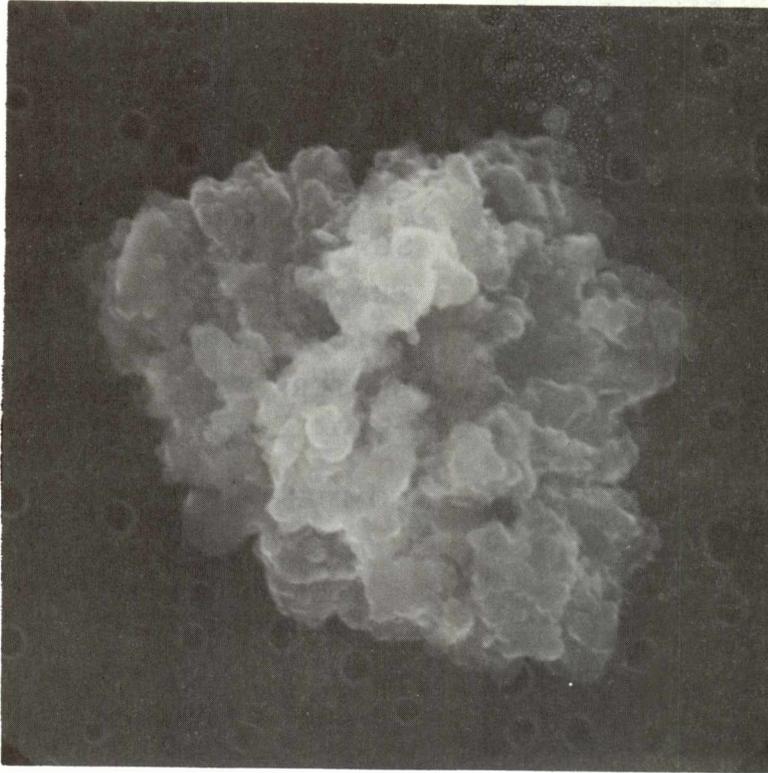
SIZE: 25
SHAPE: I
TRANS.: O
COLOR: Gold, Green to Black
LUSTER: SM/D
TYPE: TCN?
COMMENTS:

S-85-42768

U22B3



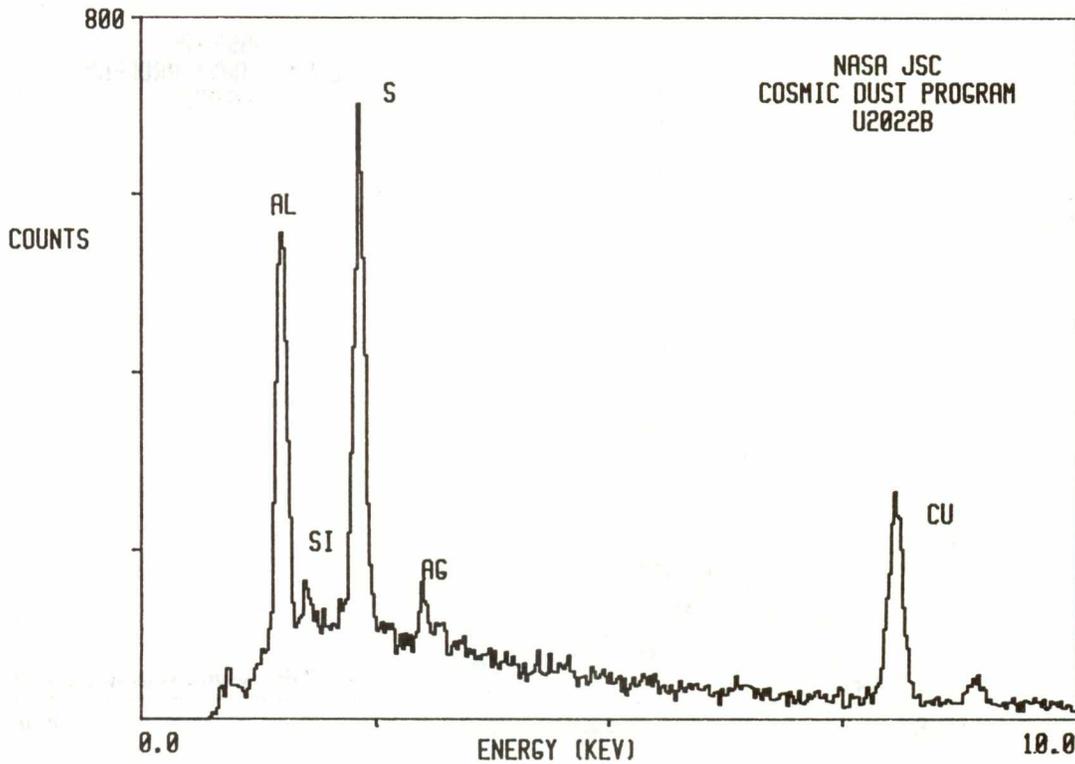
U2022 B 11



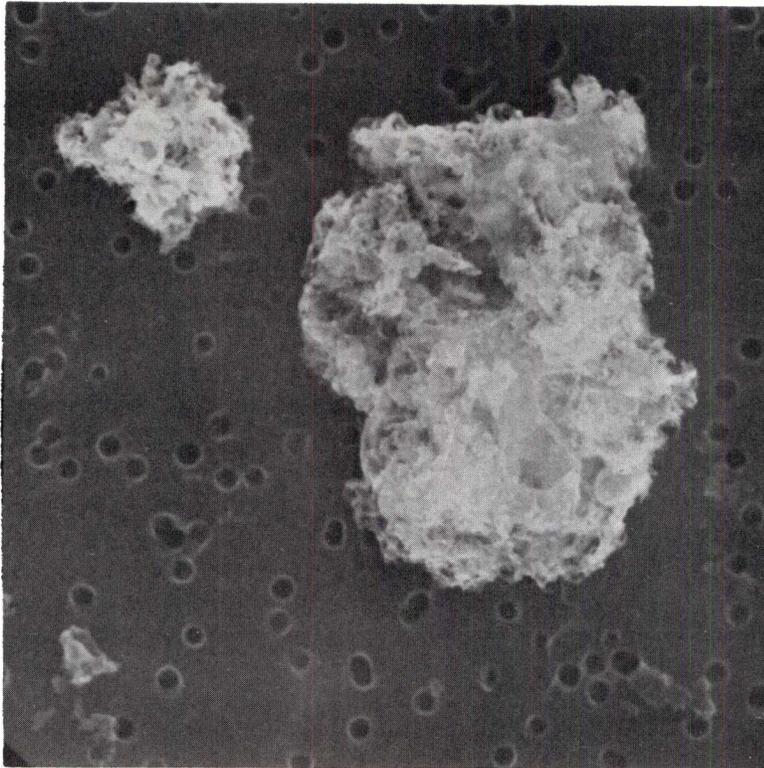
SIZE: 8
SHAPE: I
TRANS.: O
COLOR: Black
LUSTER: D
TYPE: TCA?
COMMENTS:

S-85-42774

U22B11



U2022 B 14

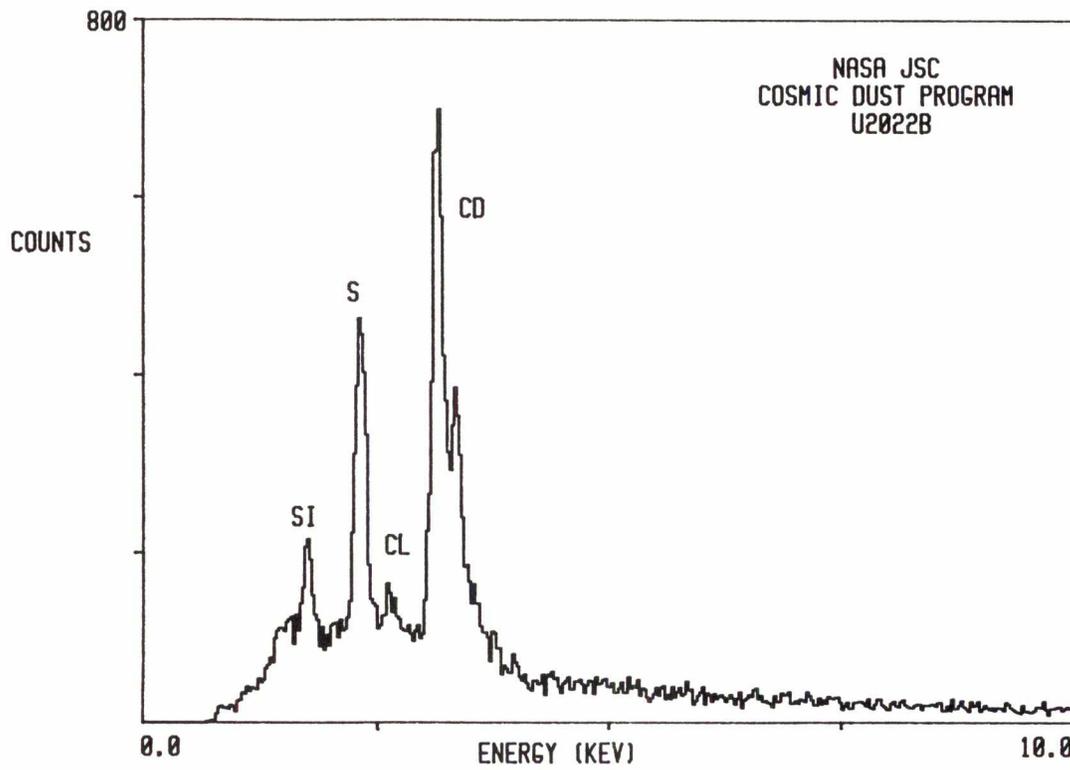


SIZE: 8
SHAPE: I
TRANS.: O
COLOR: Yellow
LUSTER: V/D
TYPE: TCA

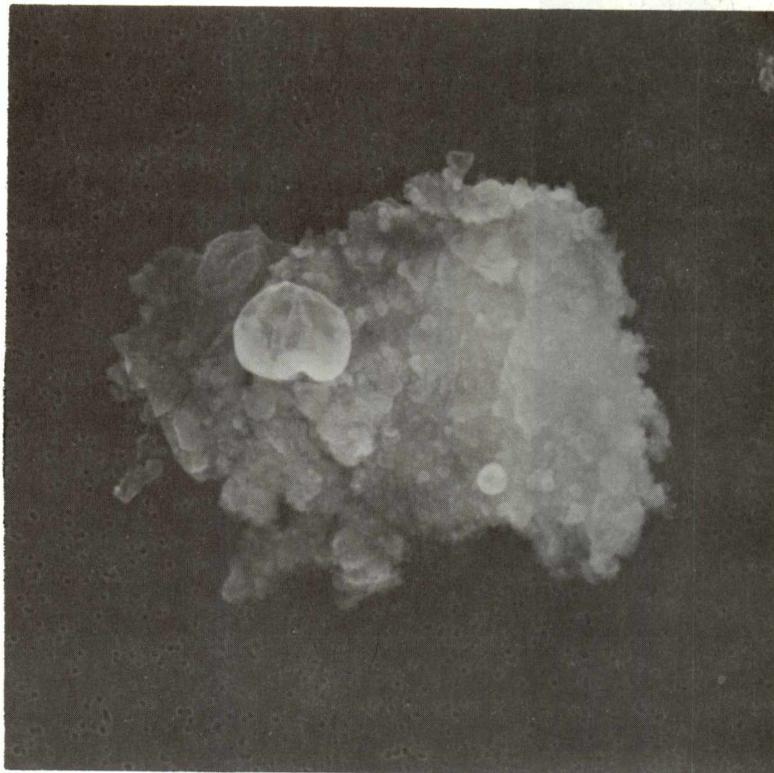
COMMENTS:
Associated with
several smaller
grains of the same
composition

S-85-42776

U22B14

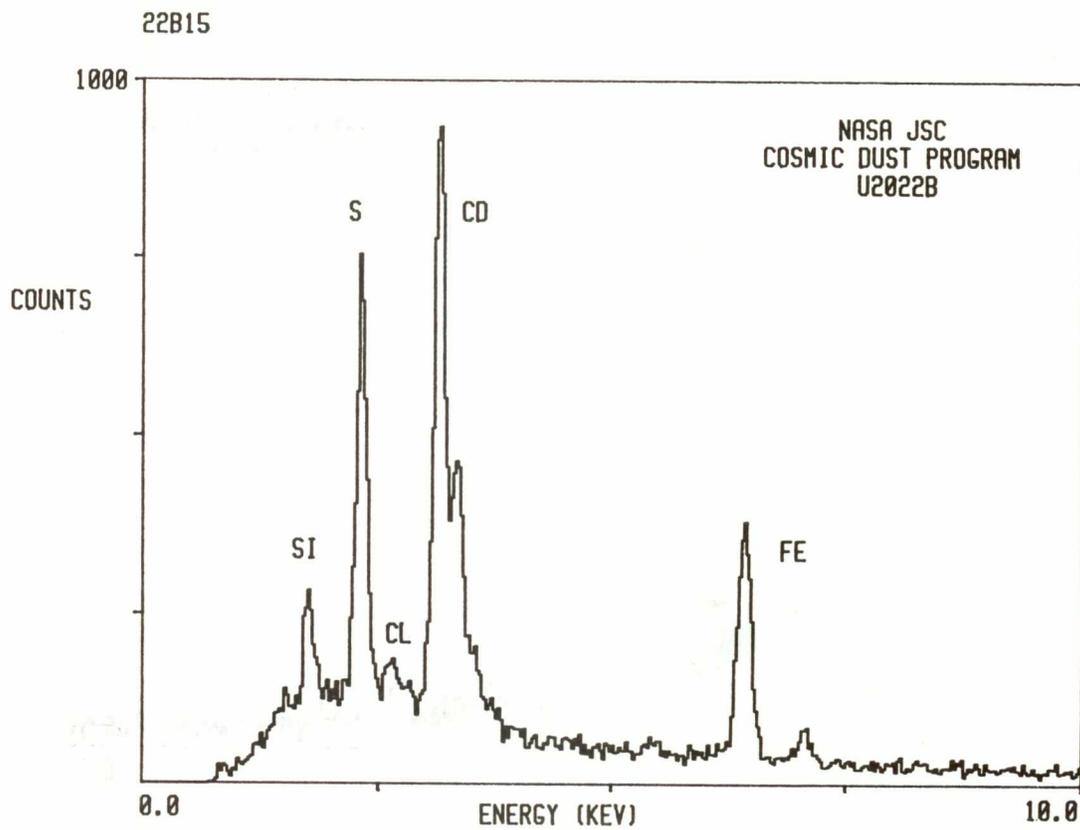


U2022 B 15

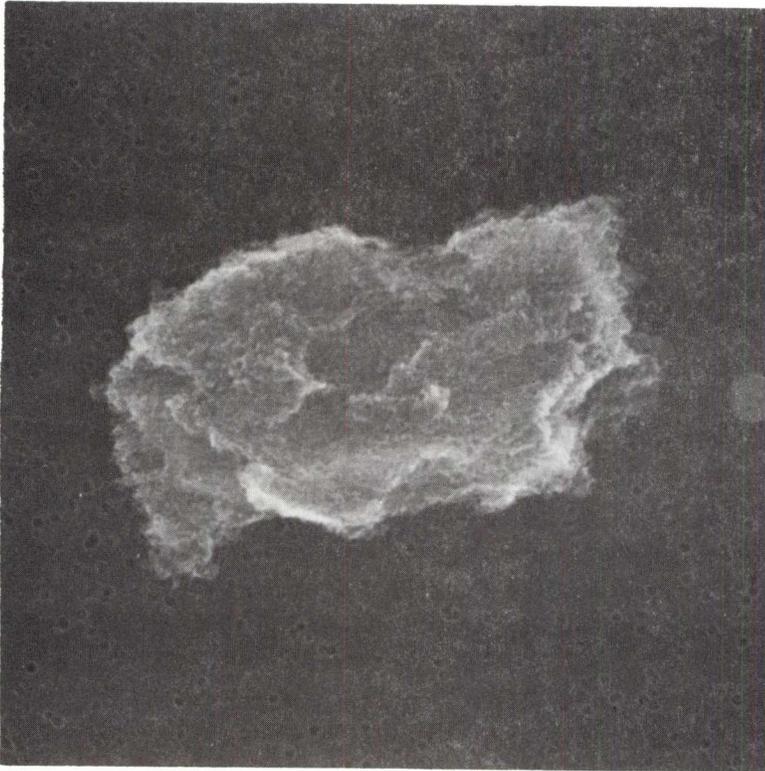


SIZE: 30x19
SHAPE: I
TRANS.: O
COLOR: Gold to Brown
LUSTER: SM/D
TYPE: TCA
COMMENTS:

S-85-42777

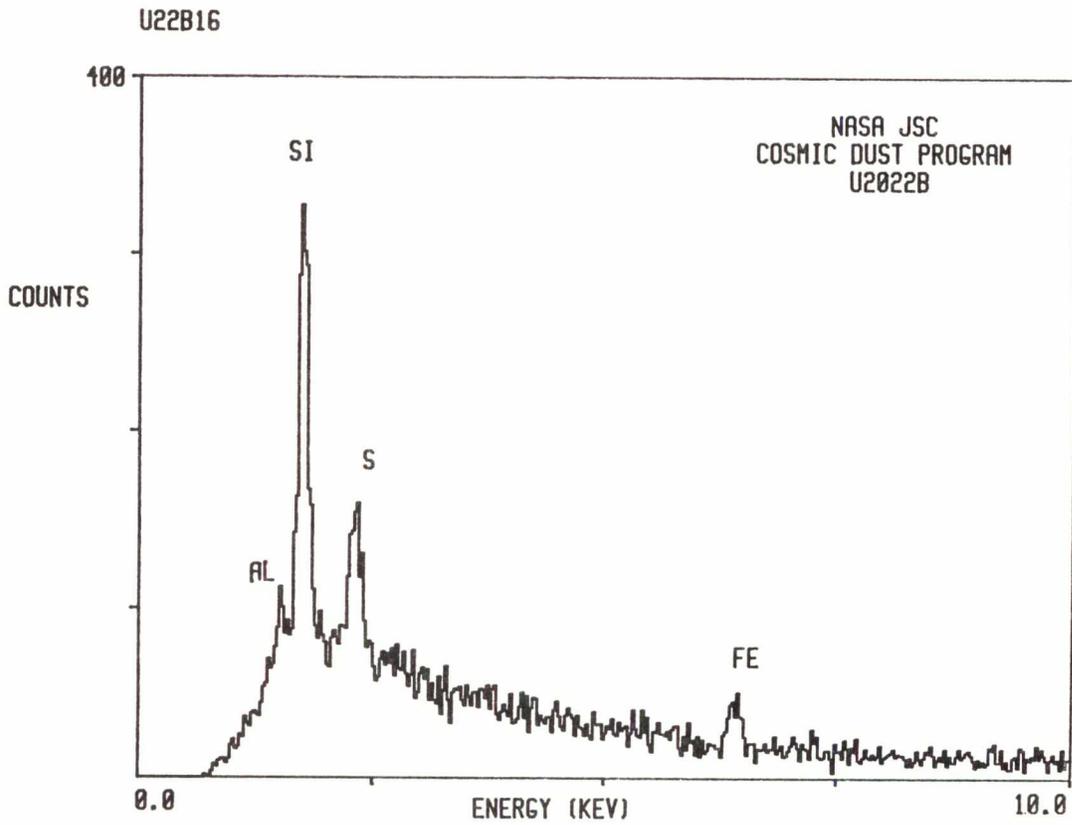


U2022 B 16



SIZE: 20x10
SHAPE: I
TRANS.: O
COLOR: Black
LUSTER: D
TYPE: TCN
COMMENTS:

S-85-42778

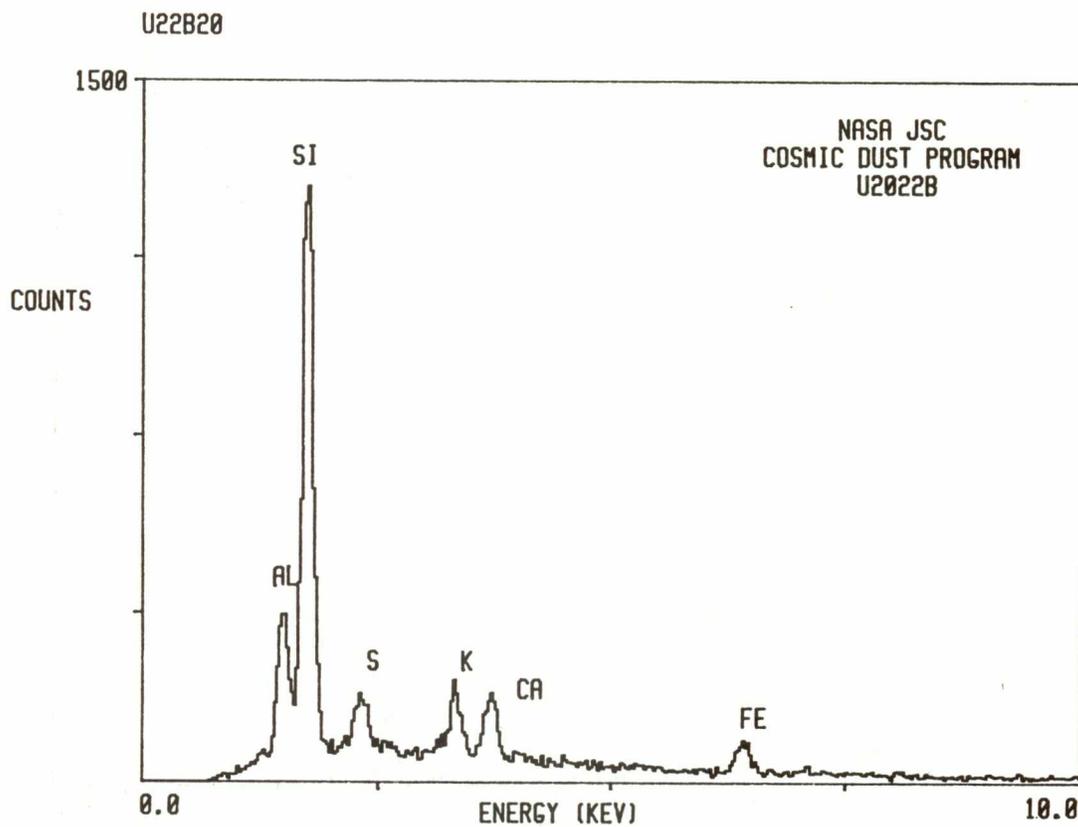


U2022 B 20

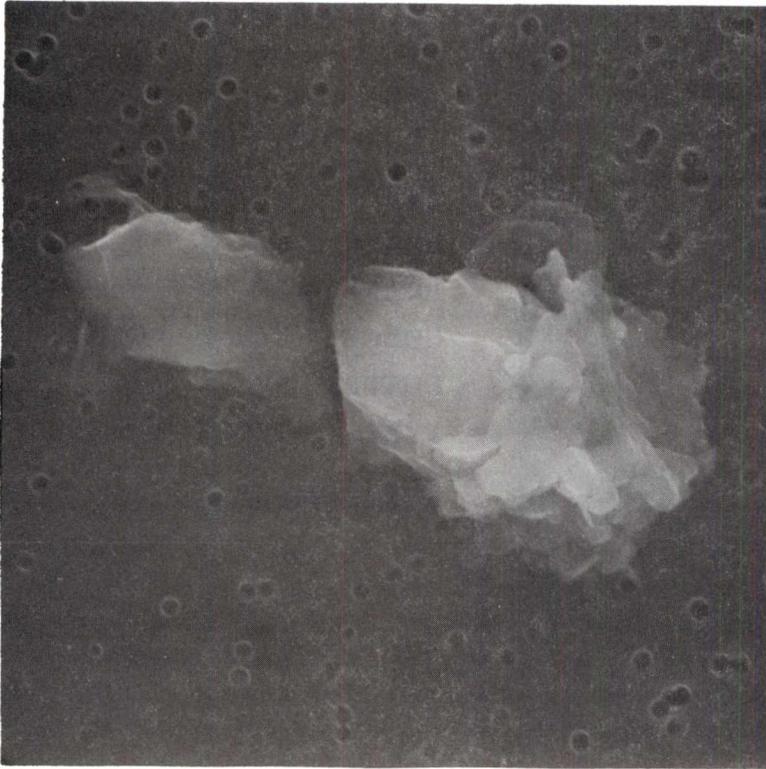


SIZE: 30x20
SHAPE: I
TRANS.: O
COLOR: Yellow to Orange
LUSTER: SV
TYPE: TCN
COMMENTS:

S-85-42780

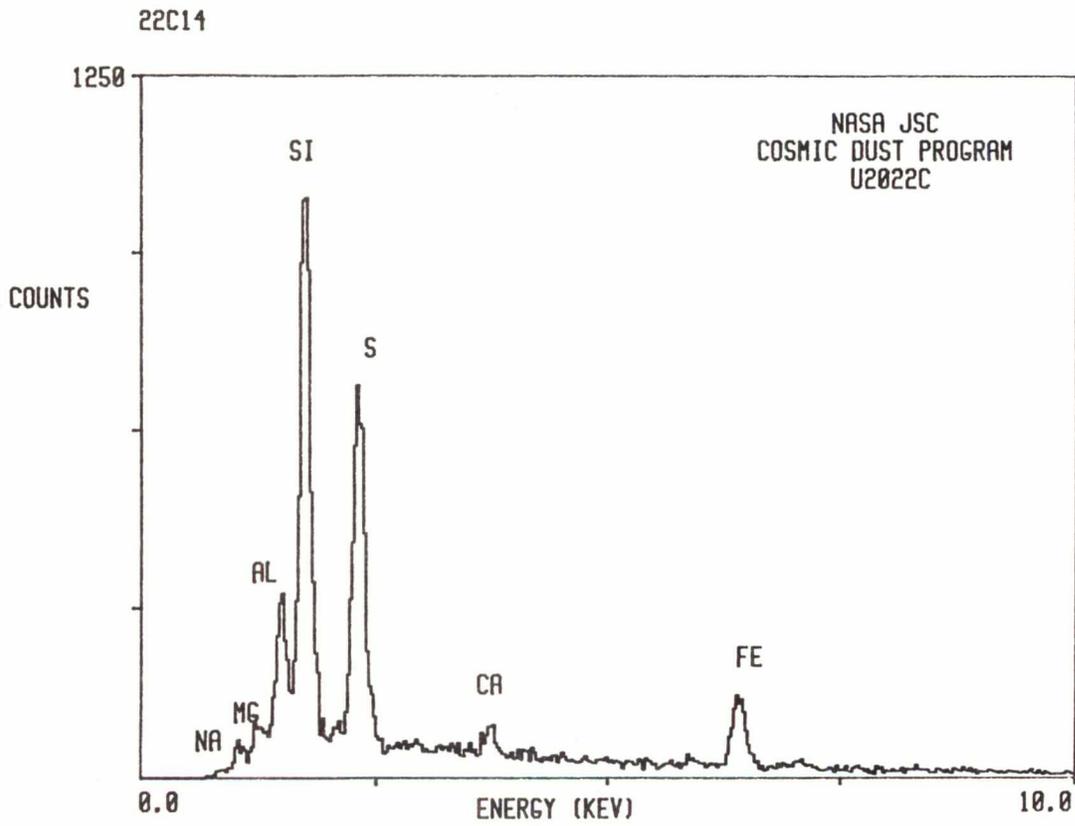


U2022 C 14



SIZE: 90
SHAPE: I
TRANS.: O
COLOR: Orange, White to Black
LUSTER: D
TYPE: TCA?
COMMENTS:

S-85-42797



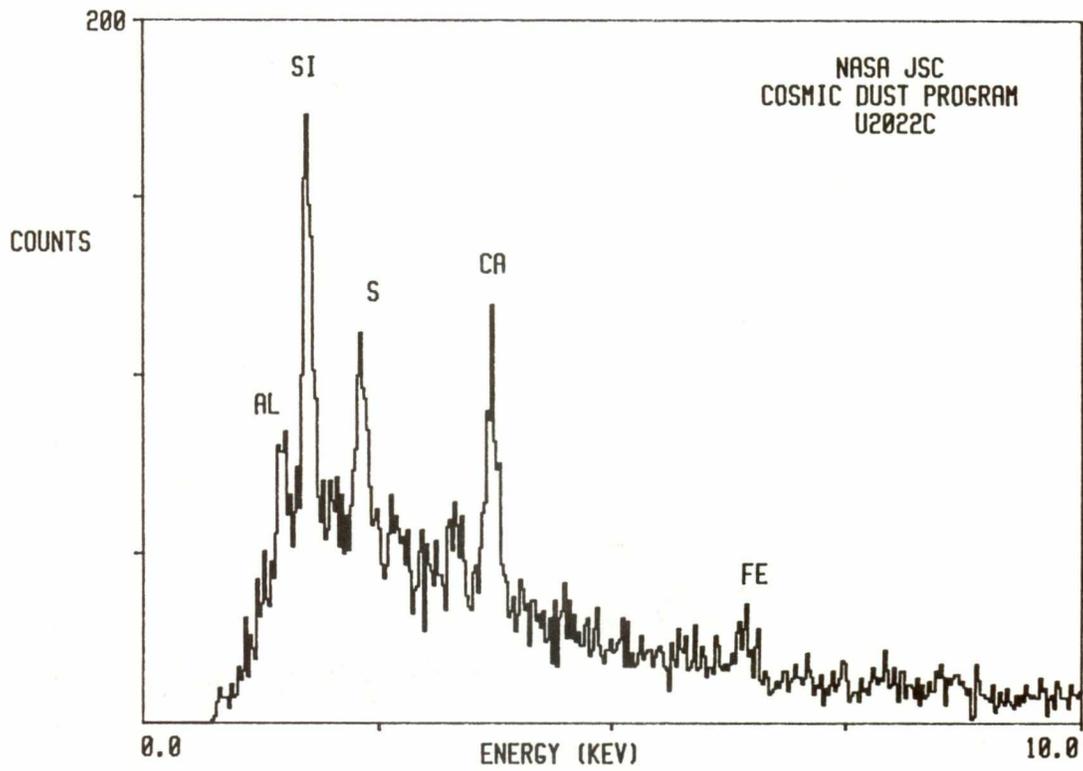
U2022 C 15



SIZE: 15
SHAPE: I
TRANS.: O
COLOR: Black to Brown
LUSTER: D
TYPE: TCN
COMMENTS:

S-85-42798

U22C15

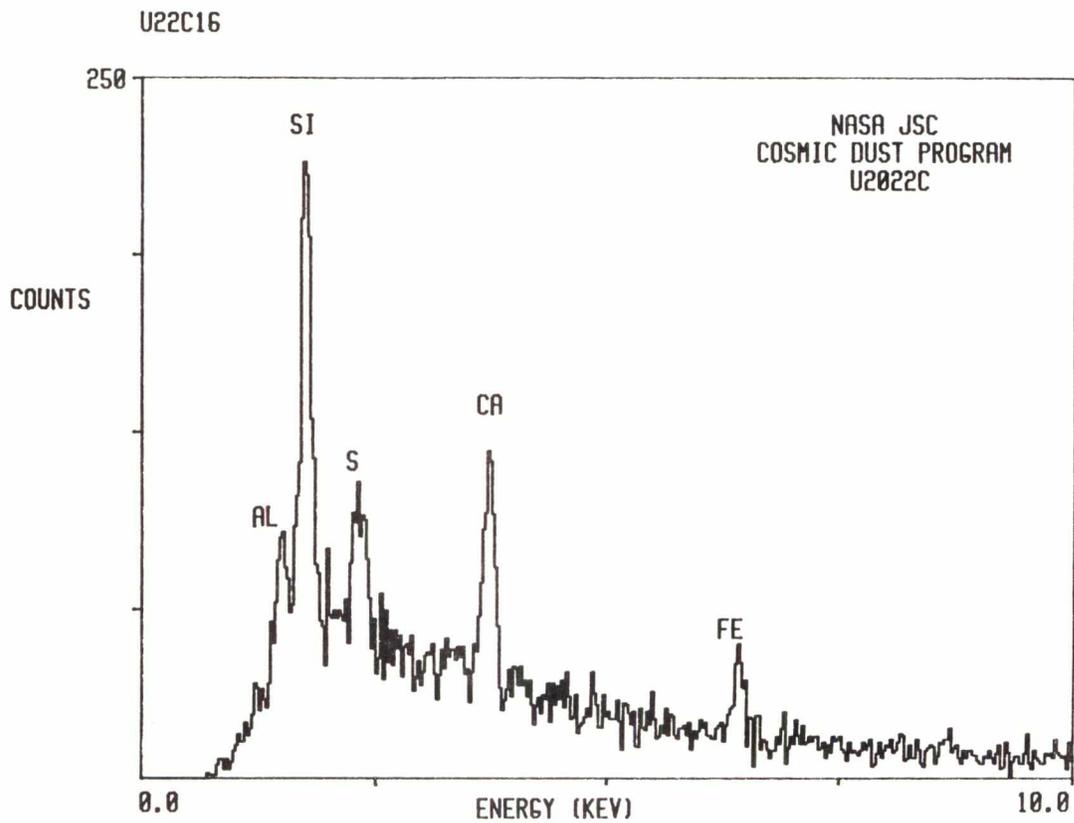


U2022 C 16

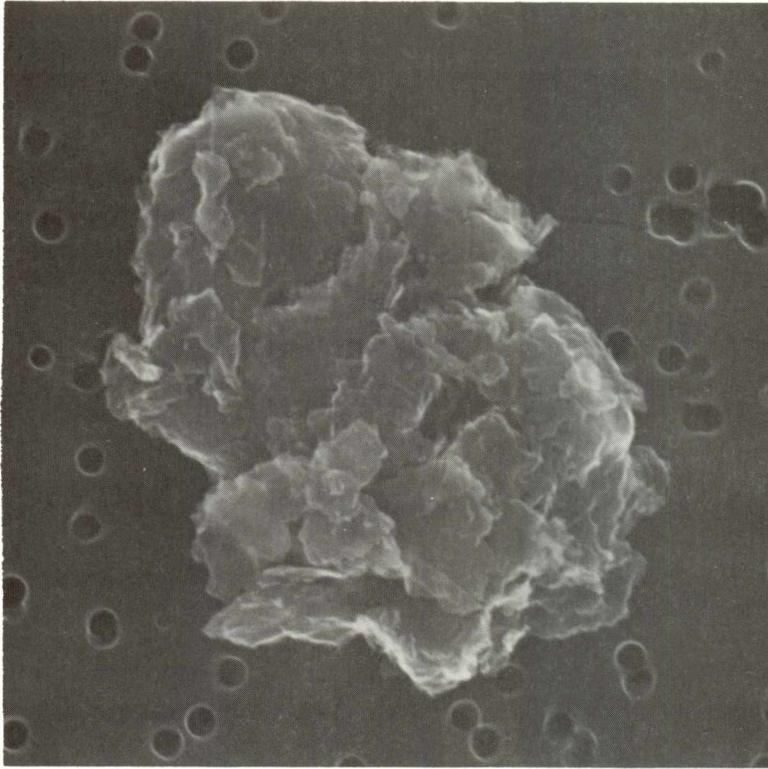


SIZE: 13x17
SHAPE: I
TRANS.: O
COLOR: Brown to Black
LUSTER: SV/D
TYPE: TCN
COMMENTS:

S-85-42799



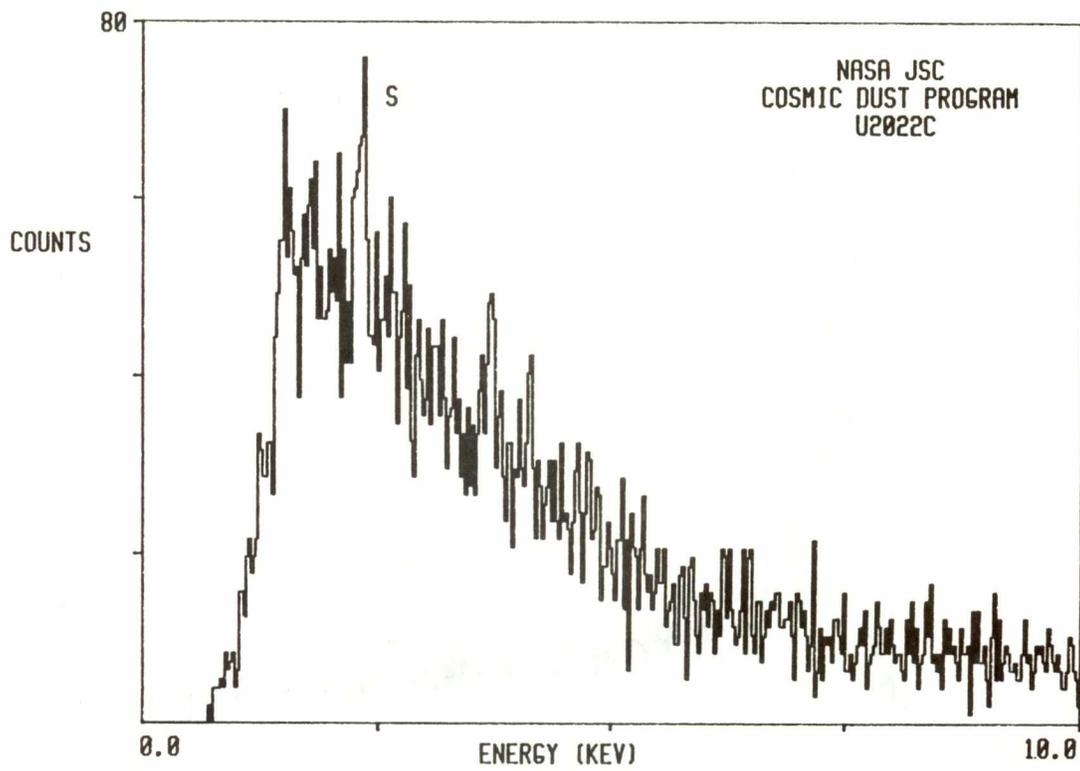
U2022 C 17



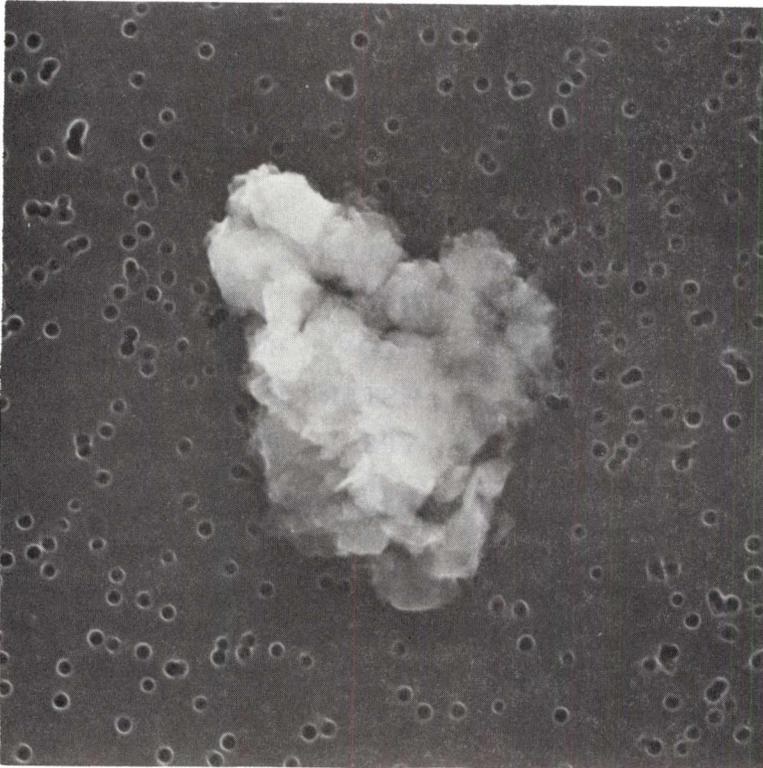
SIZE: 7
SHAPE: I
TRANS.: O
COLOR: Black
LUSTER: D
TYPE: TCN
COMMENTS:

S-85-42800

U22C17



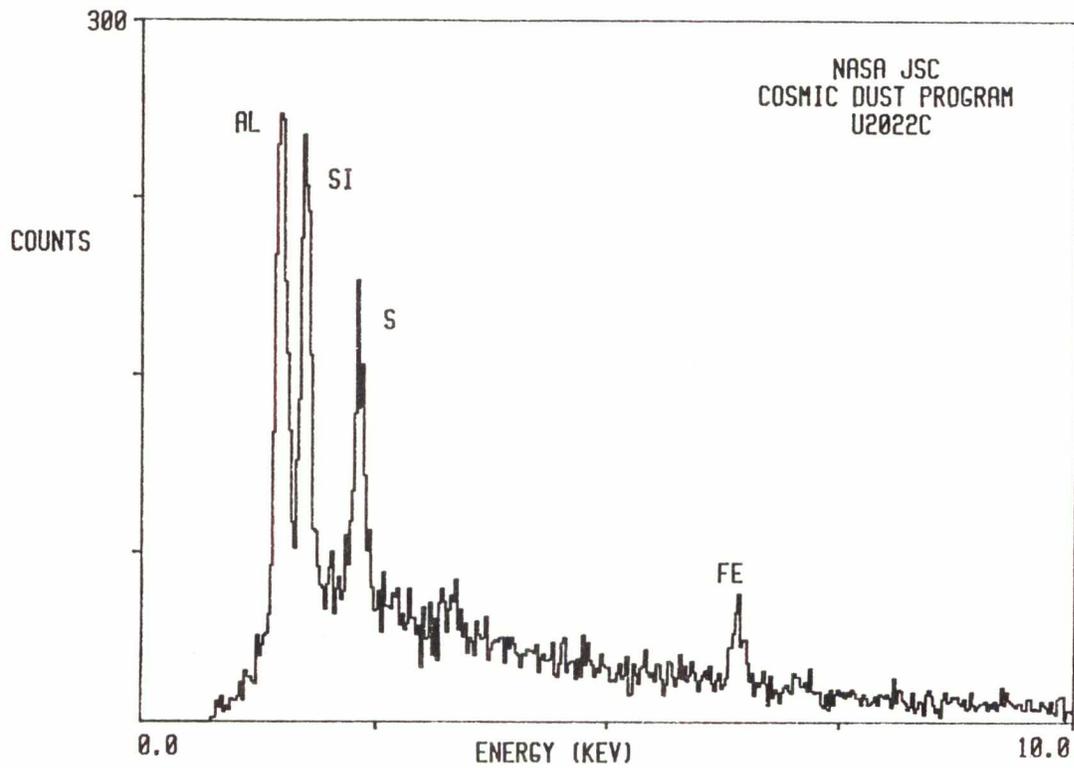
U2022 C 19



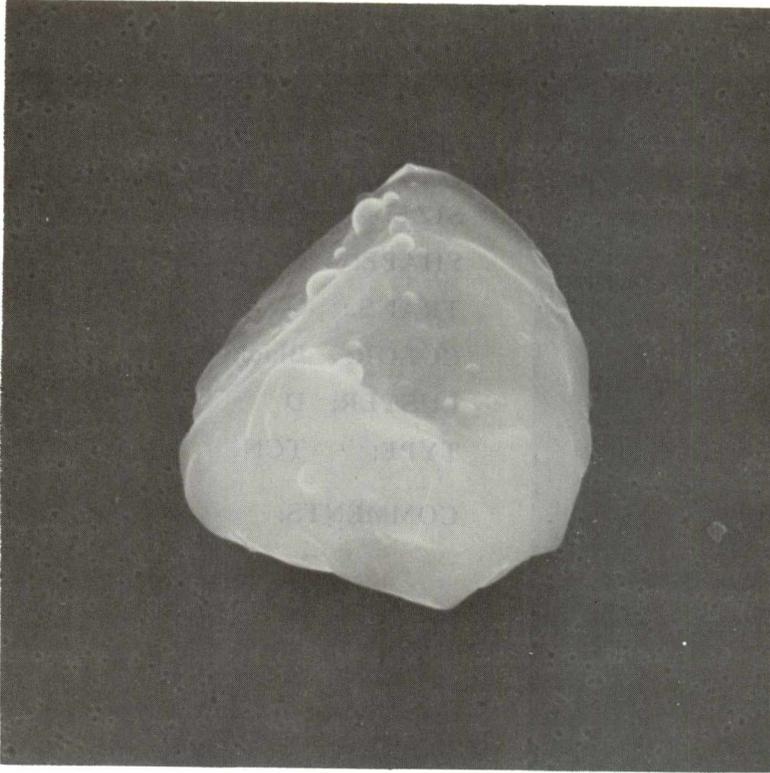
SIZE: 12x10
SHAPE: I
TRANS.: O
COLOR: Yellow
LUSTER: SV
TYPE: TCA?
COMMENTS:

S-85-42802

U22C19



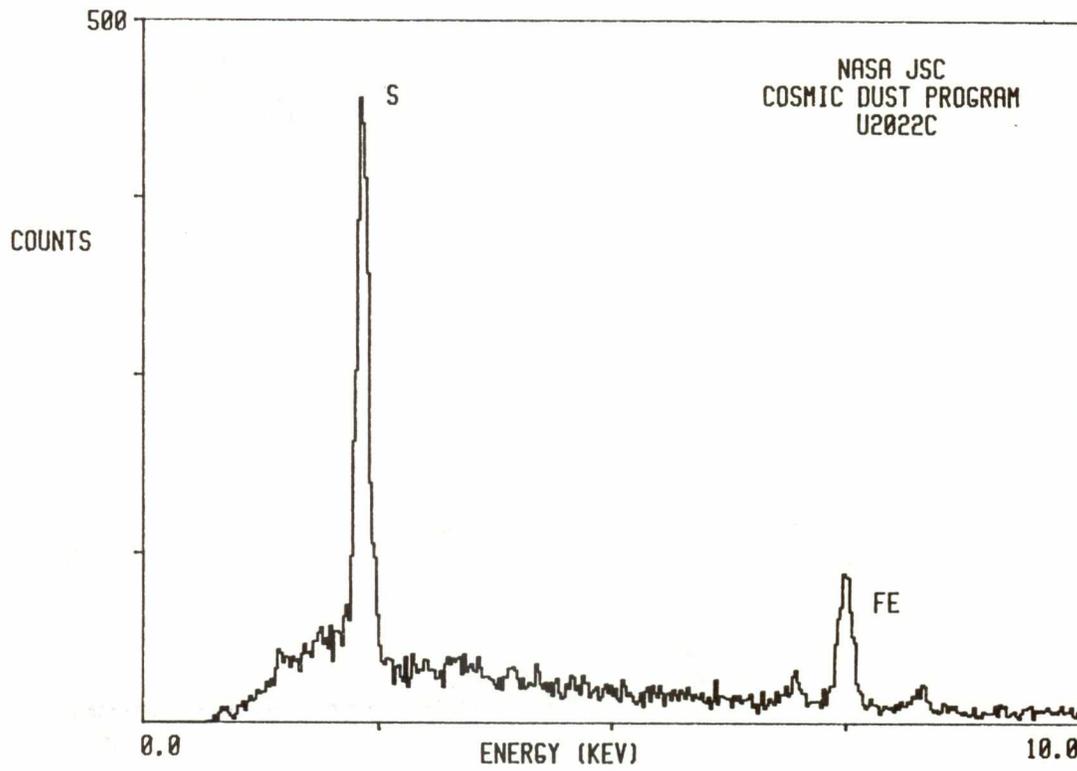
U2022 C 20



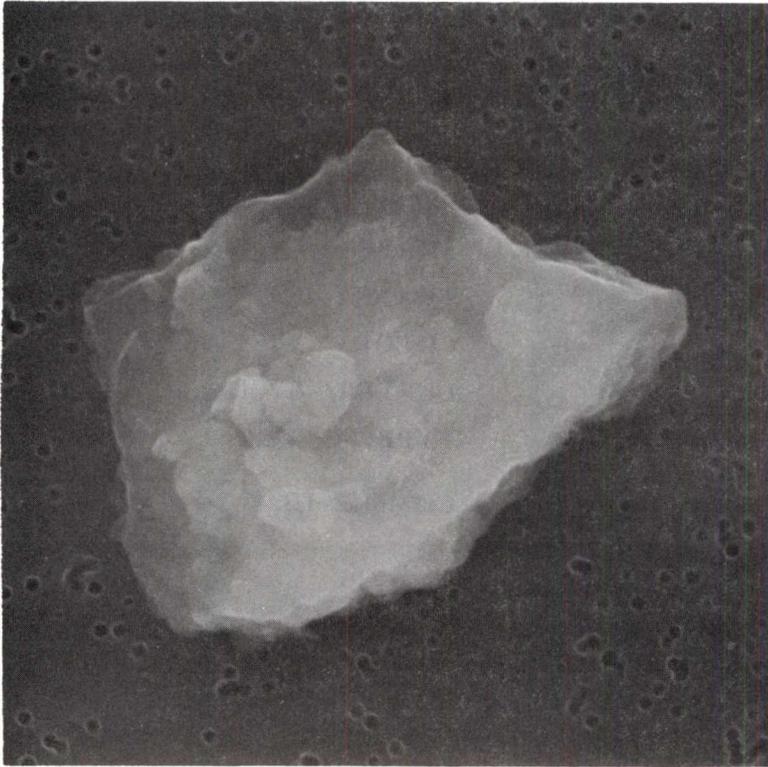
SIZE: 22
SHAPE: I
TRANS.: O
COLOR: White
LUSTER: SV/D
TYPE: TCA?
COMMENTS:

S-85-42803

U22C20

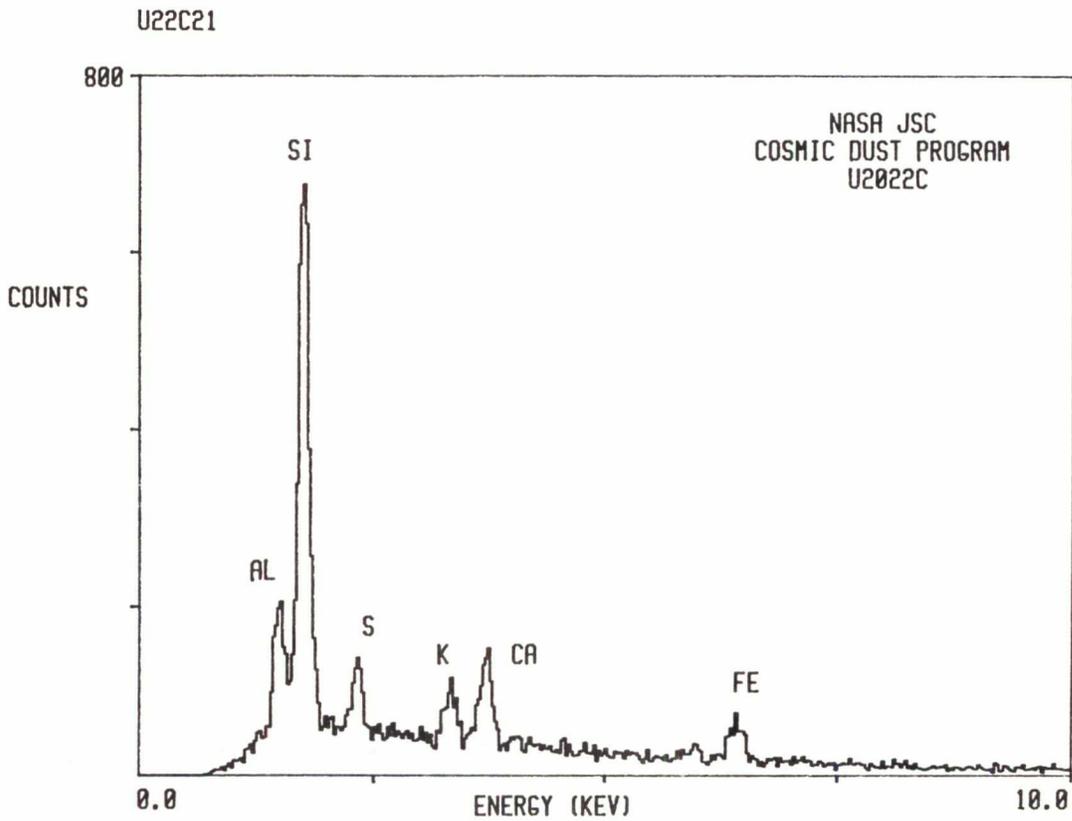


U2022 C 21

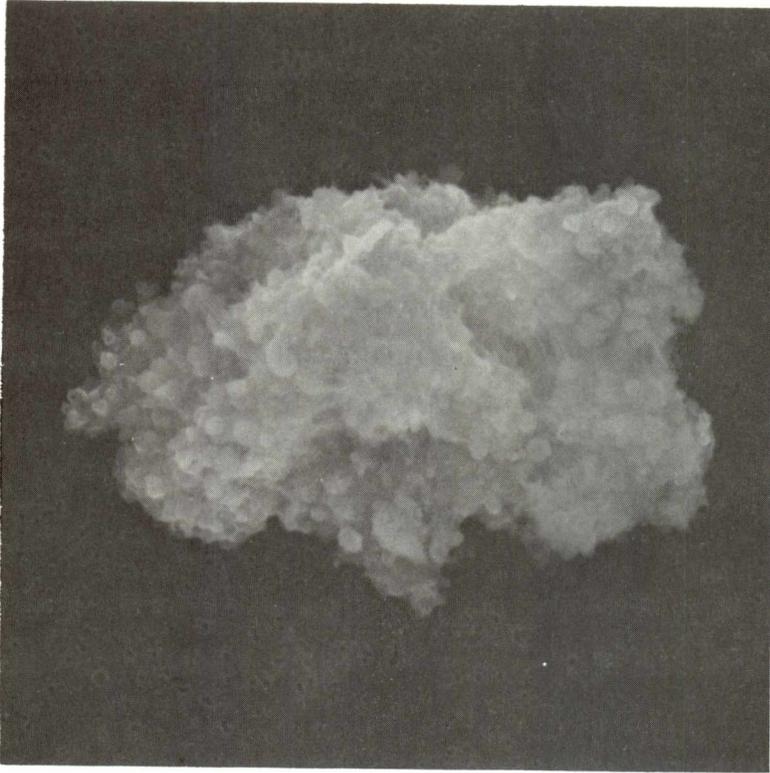


SIZE: 15x13
SHAPE: I
TRANS.: O
COLOR: Black
LUSTER: D
TYPE: TCN
COMMENTS:

S-85-42804

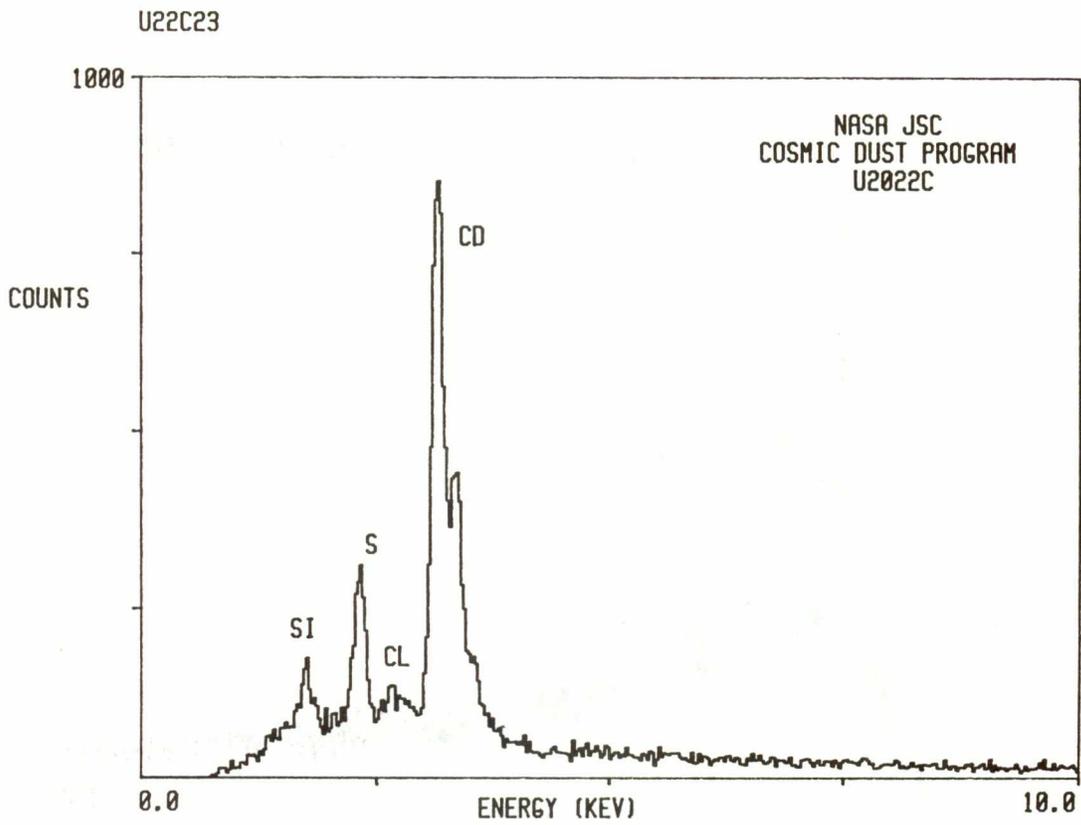


U2022 C 23

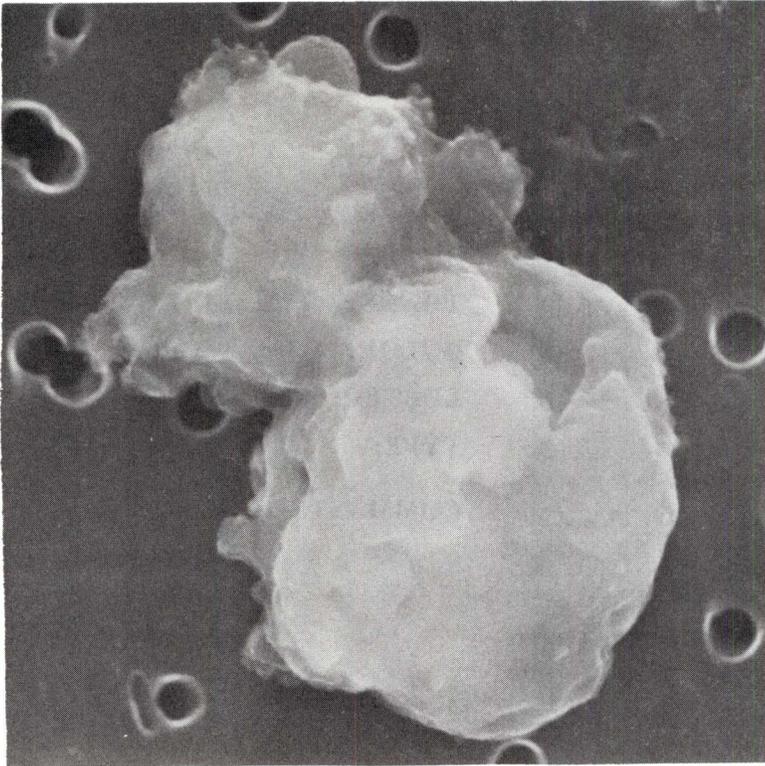


SIZE: 30x20
SHAPE: I
TRANS.: O
COLOR: Green, Yellow
LUSTER: SM
TYPE: TCA
COMMENTS:

S-85-42805



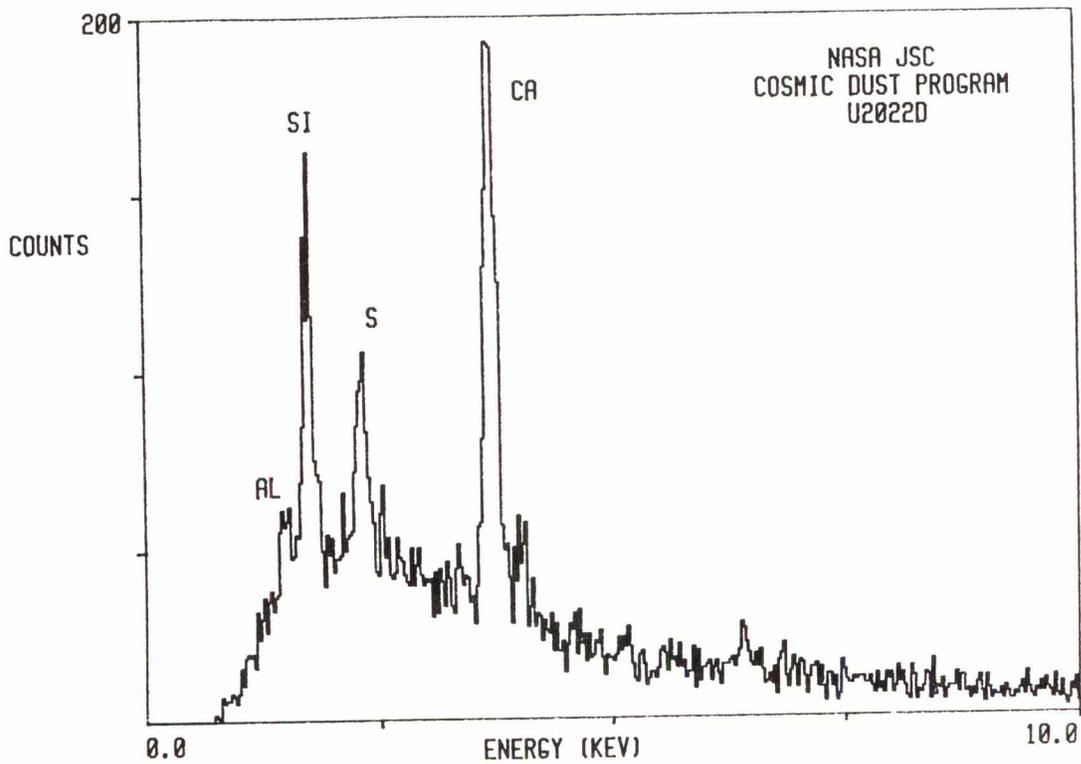
U2022 D 1



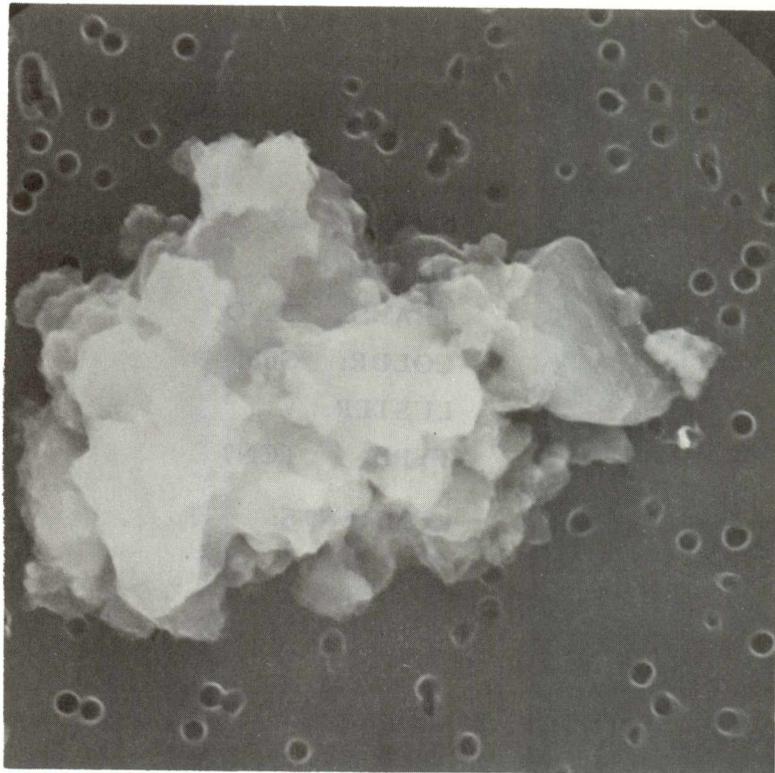
SIZE: 13x10
SHAPE: I
TRANS.: O
COLOR: Black
LUSTER: D
TYPE: TCN
COMMENTS:

S-85-42815

U22D1



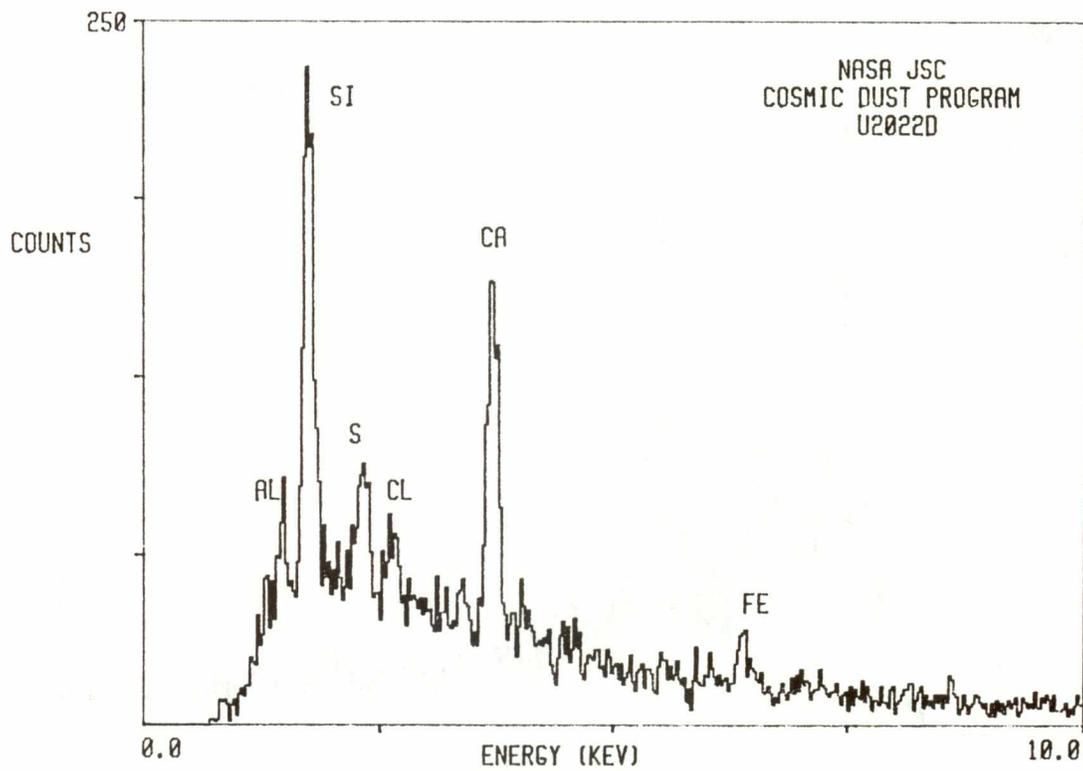
U2022 D 2



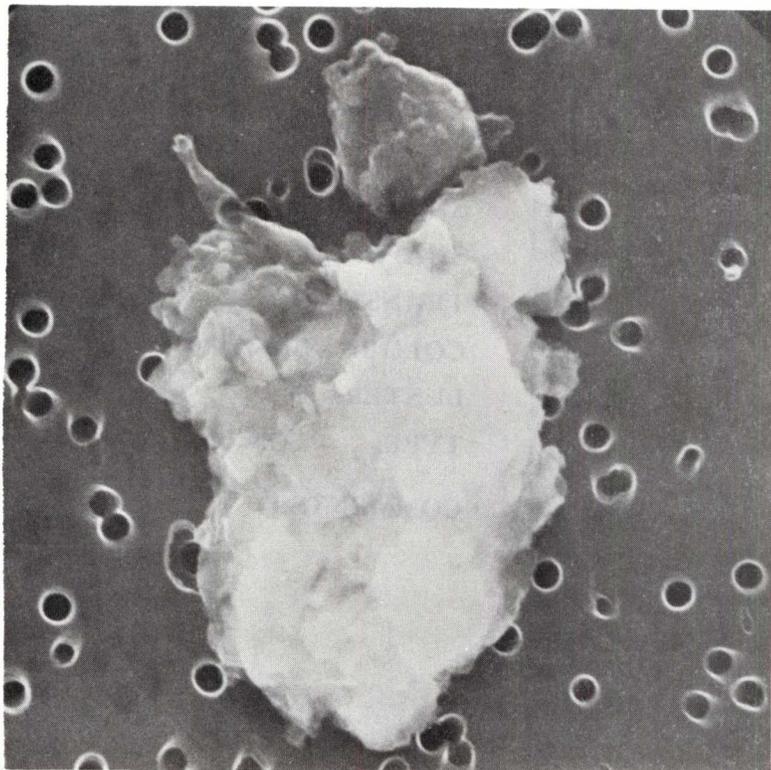
SIZE: 28
SHAPE: I
TRANS.: O
COLOR: Brown to Black
LUSTER: D
TYPE: TCN
COMMENTS:

S-85-42816

U2202

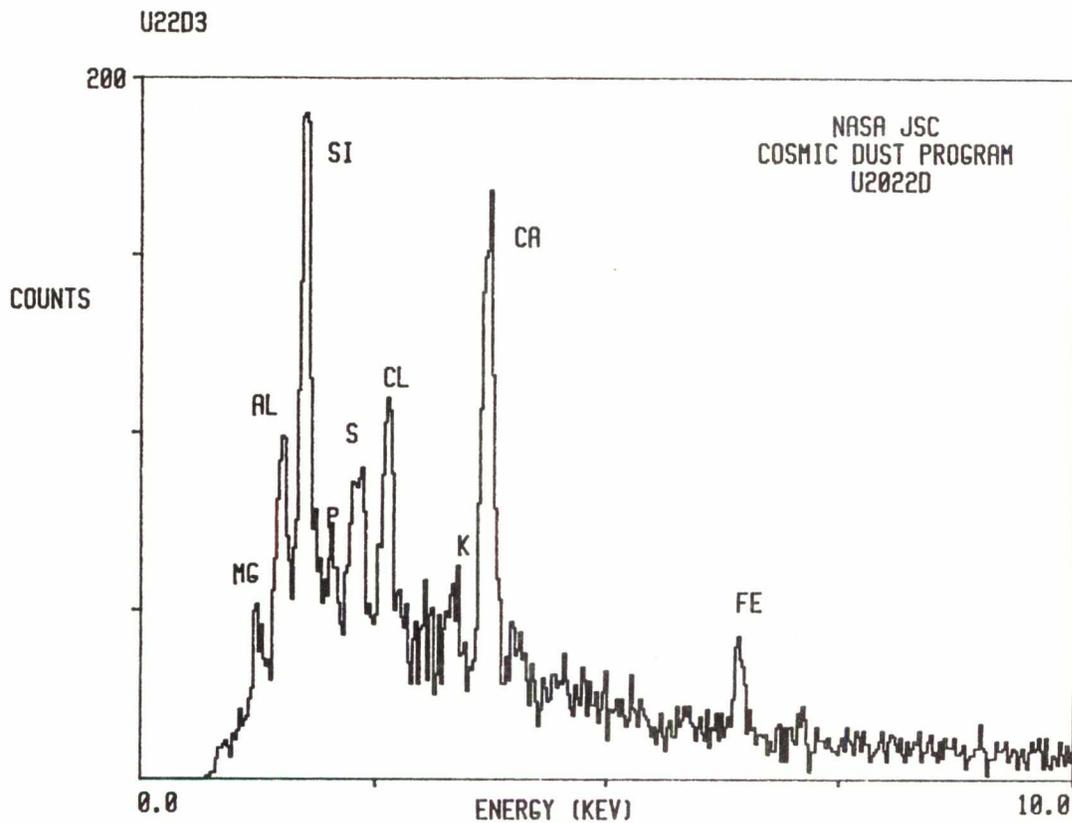


U2022 D 3

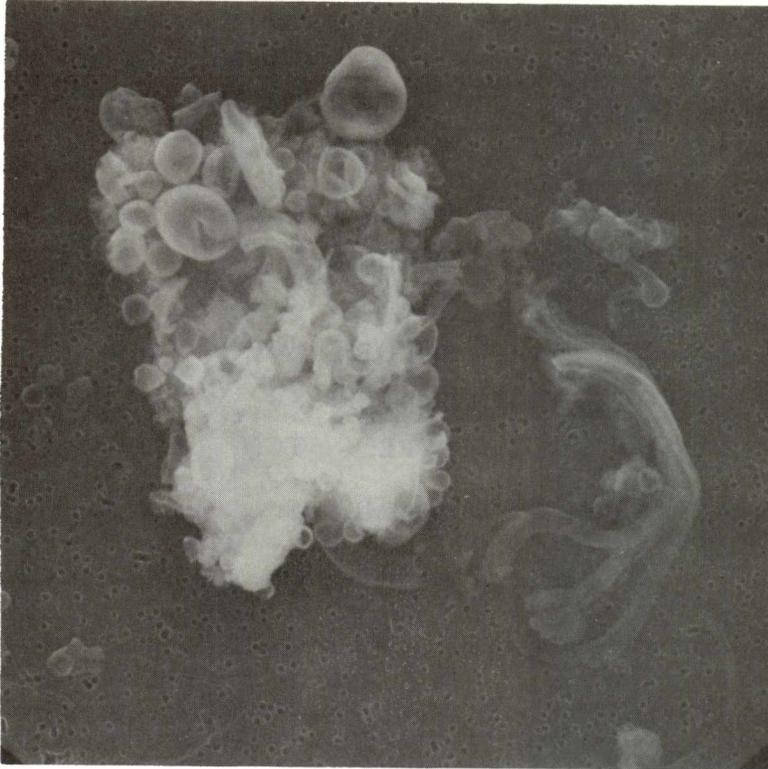


SIZE: 28
SHAPE: I
TRANS.: TL/O
COLOR: Gold
LUSTER: V
TYPE: TCN?
COMMENTS:

S-85-42817



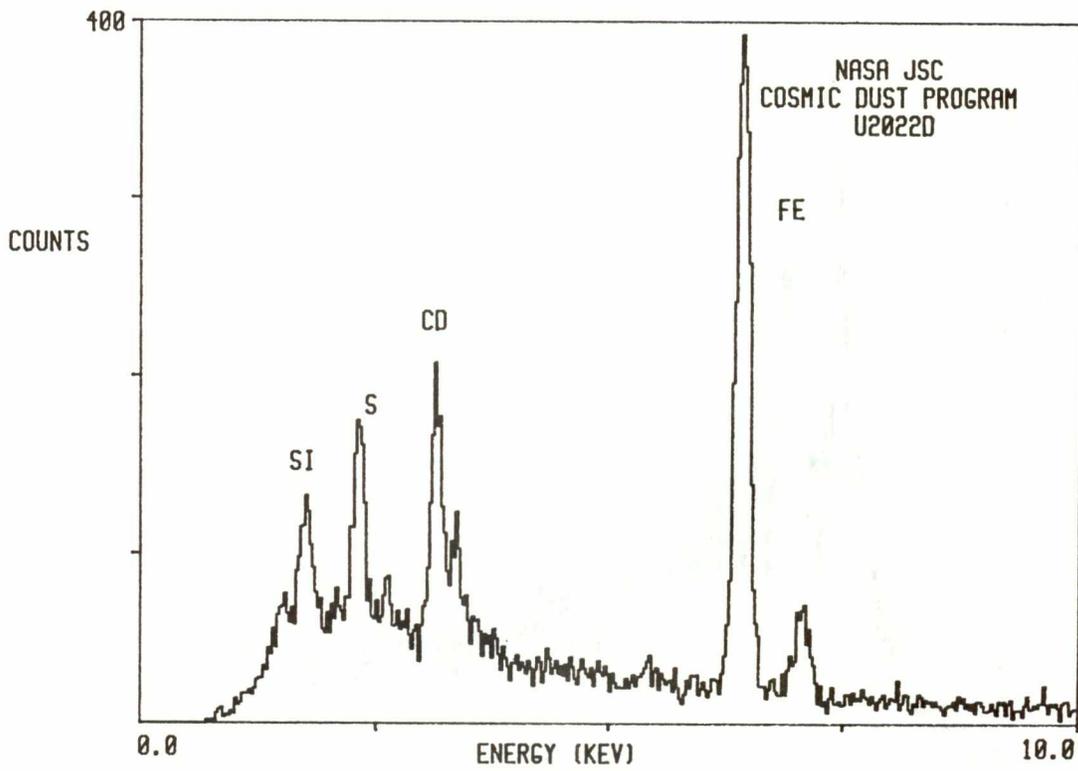
U2022 D 4



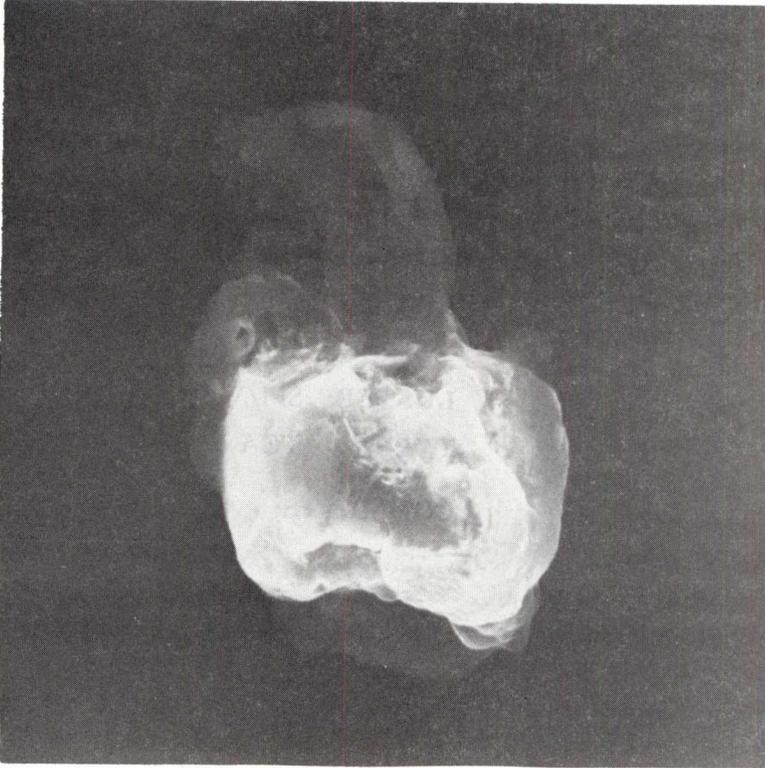
SIZE: 22x17
SHAPE: I
TRANS.: O
COLOR: Gold
LUSTER: SM/V
TYPE: TCA
COMMENTS:

S-85-42818

U22D4



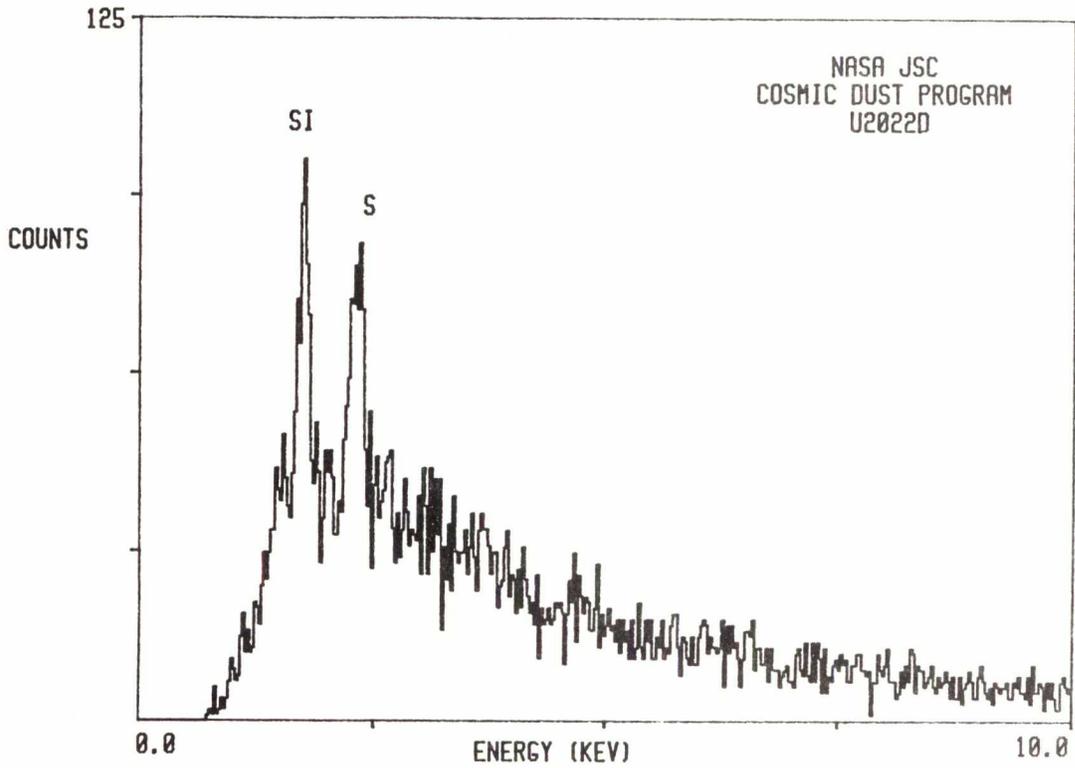
U2022 D 5



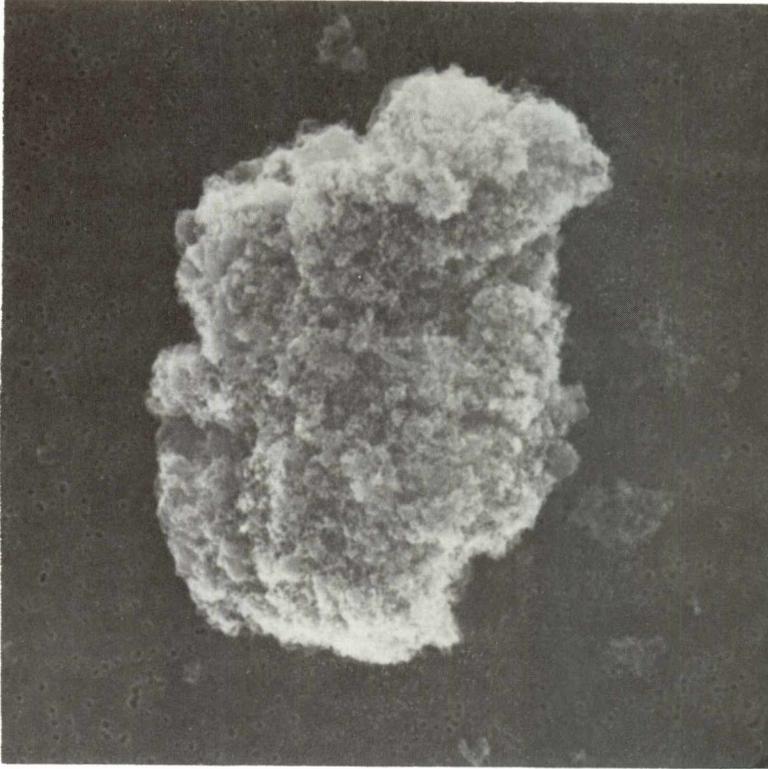
SIZE:
SHAPE: I
TRANS.: O
COLOR: White
LUSTER: SV
TYPE: TCN
COMMENTS:

S-85-42819

U2205



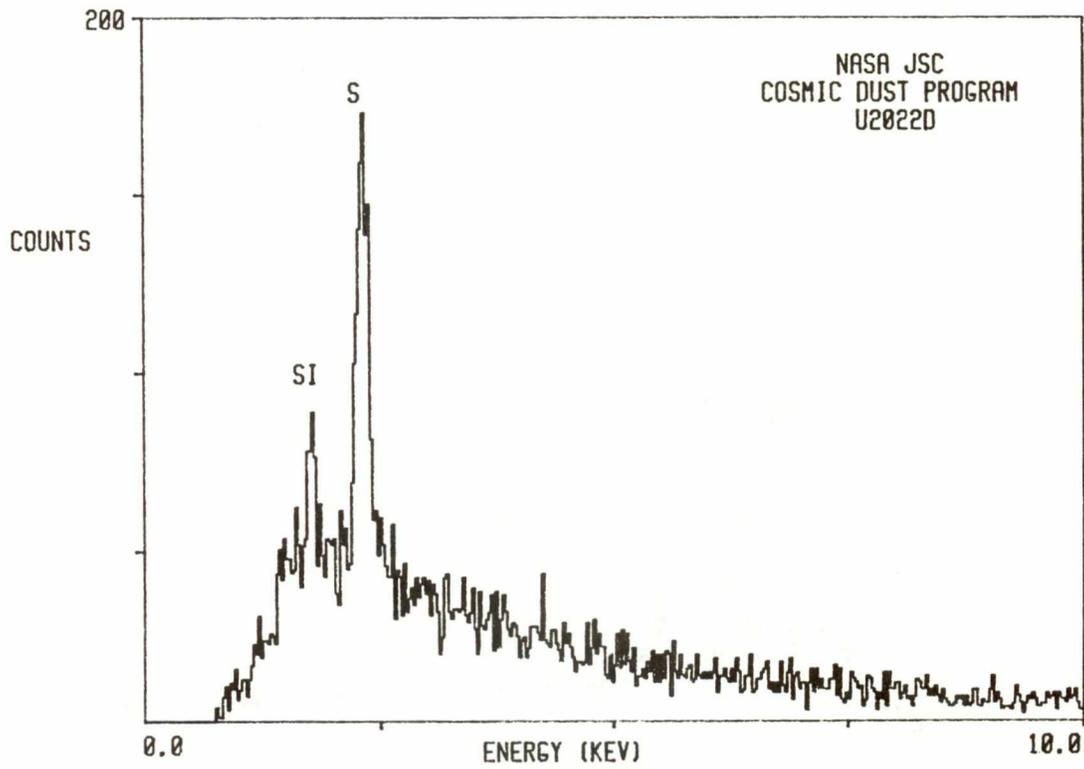
U2022 D 6



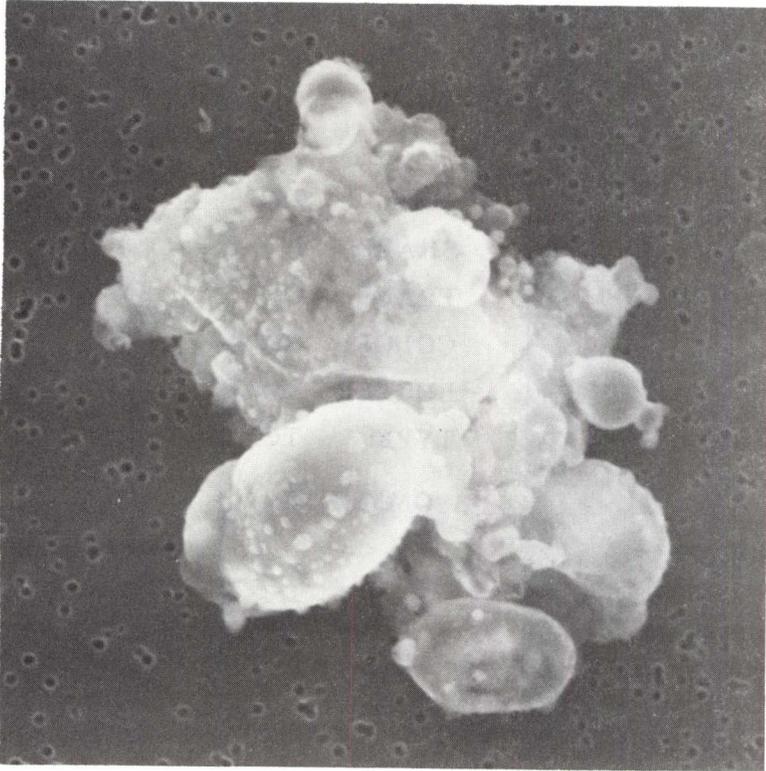
SIZE: 25x29
SHAPE: I
TRANS.: O
COLOR: Black
LUSTER: SM/V
TYPE: TCN
COMMENTS:

S-85-42820

U2206



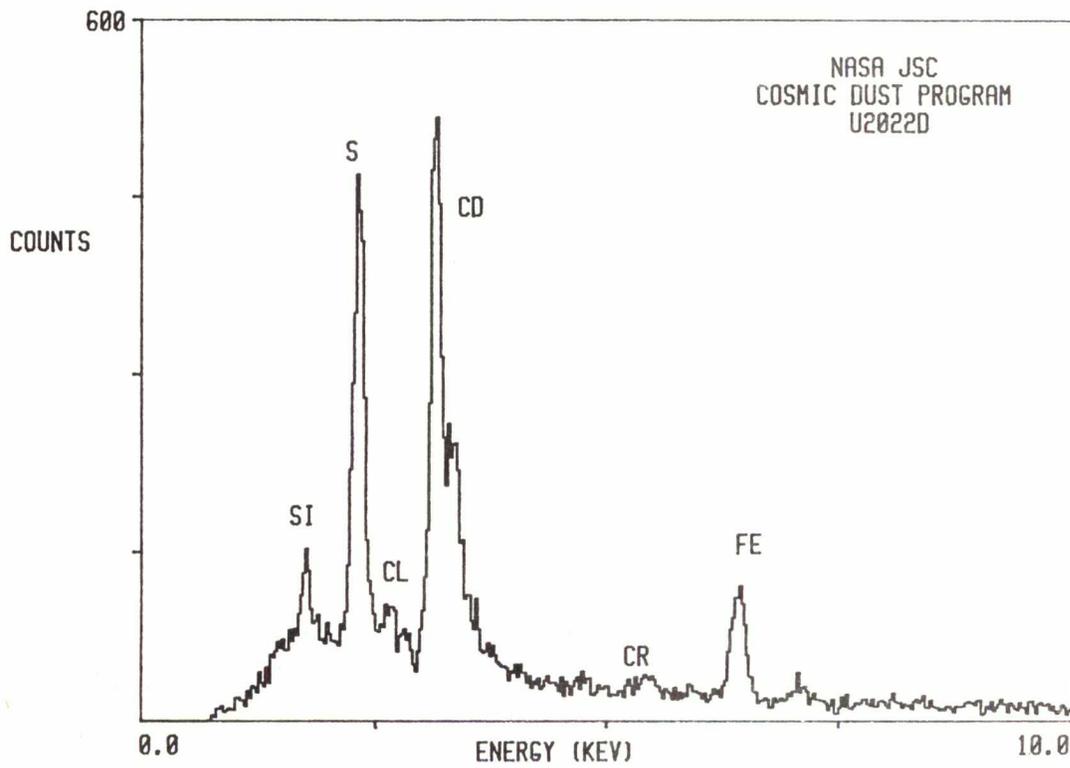
U2022 D 13



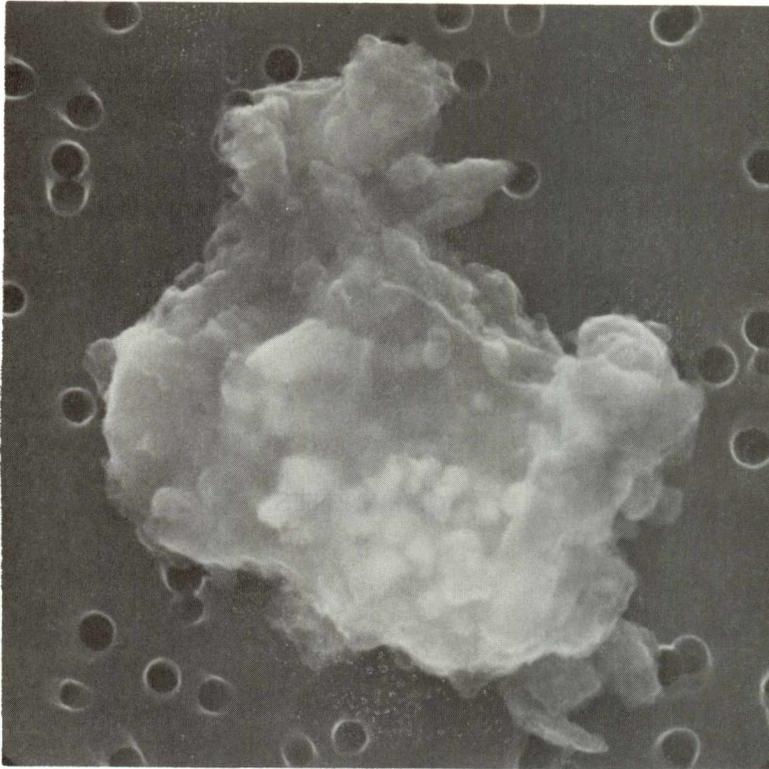
SIZE: 20
SHAPE: I
TRANS.: O
COLOR: Yellow
LUSTER: D
TYPE: TCA
COMMENTS:

S-85-42810

U22D13



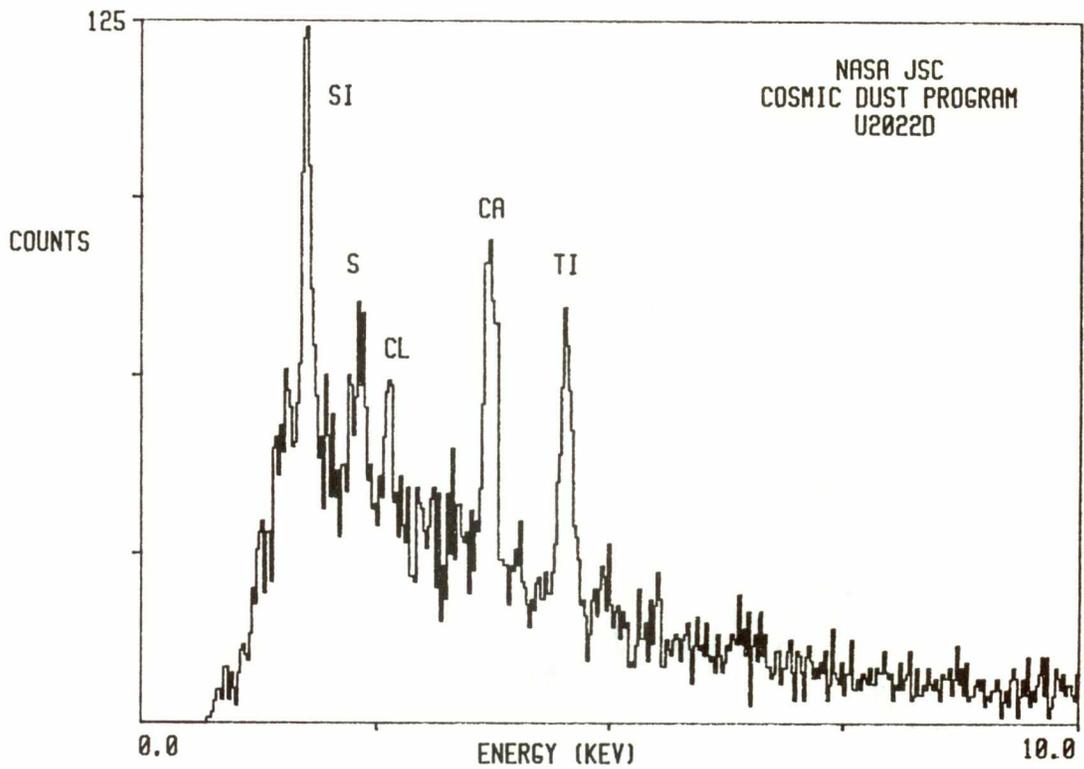
U2022 D 16



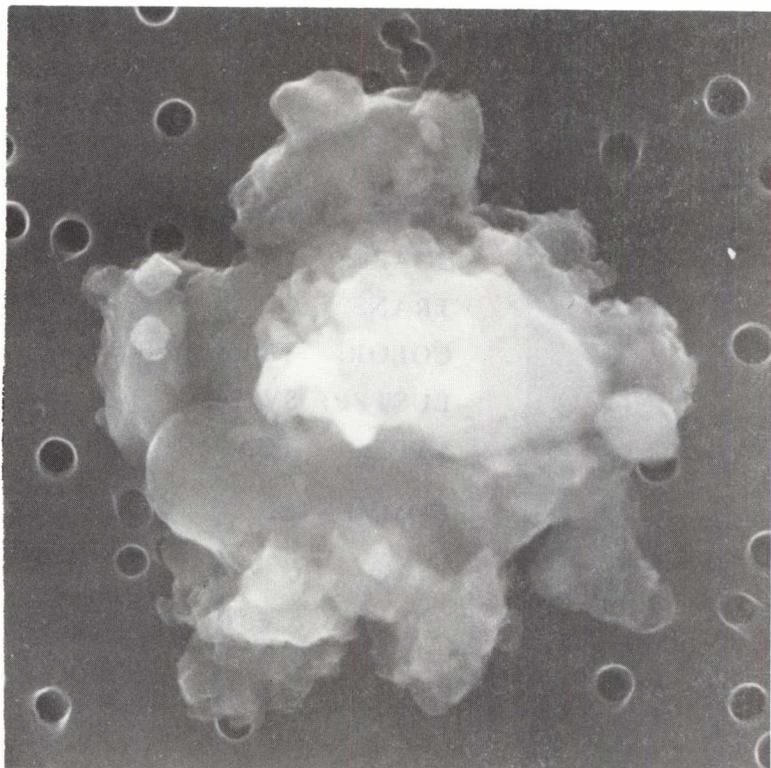
SIZE: 25x22
SHAPE: I
TRANS.: O
COLOR: Yellow to Black
LUSTER: SV/D
TYPE: TCA
COMMENTS:

S-85-42812

U22D16

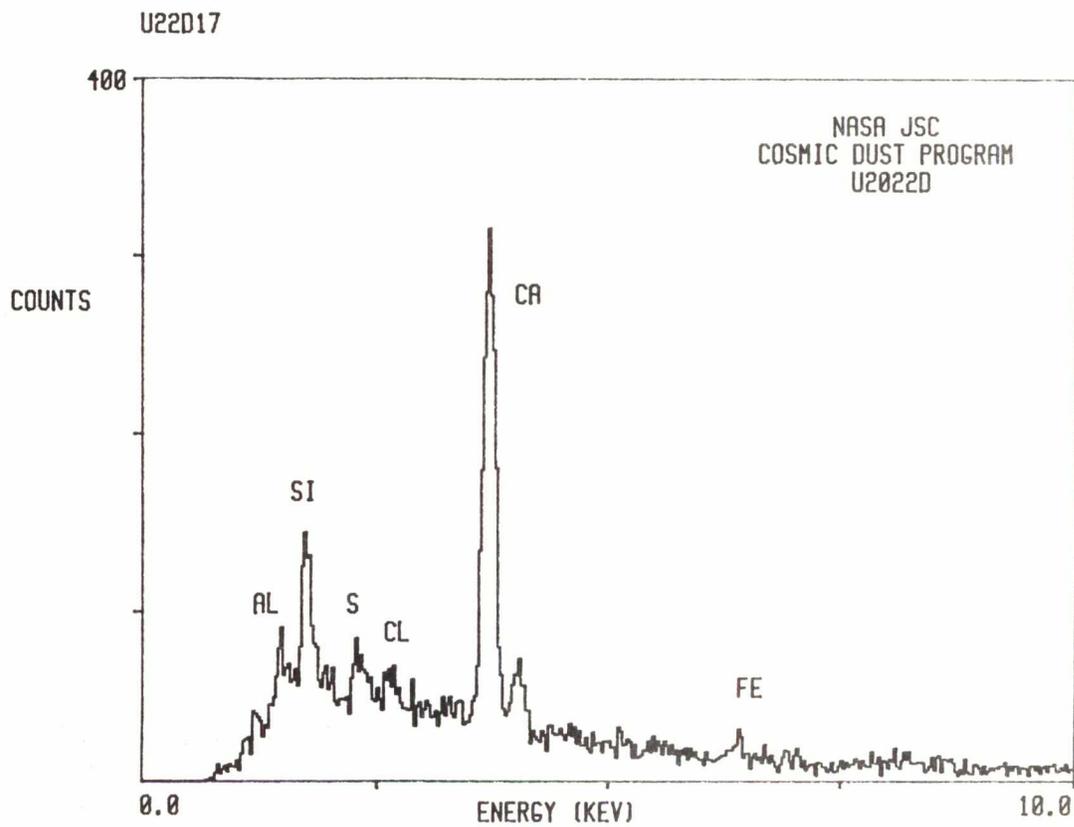


U2022 D 17

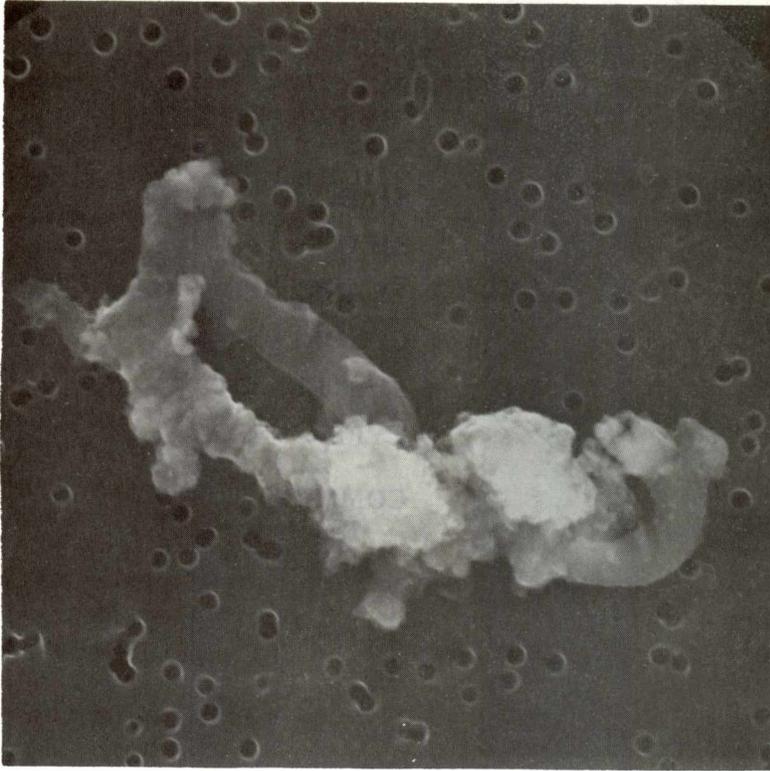


SIZE: 15
SHAPE: I
TRANS.: O
COLOR: ?
LUSTER: ?
TYPE: TCN
COMMENTS:

S-85-42813



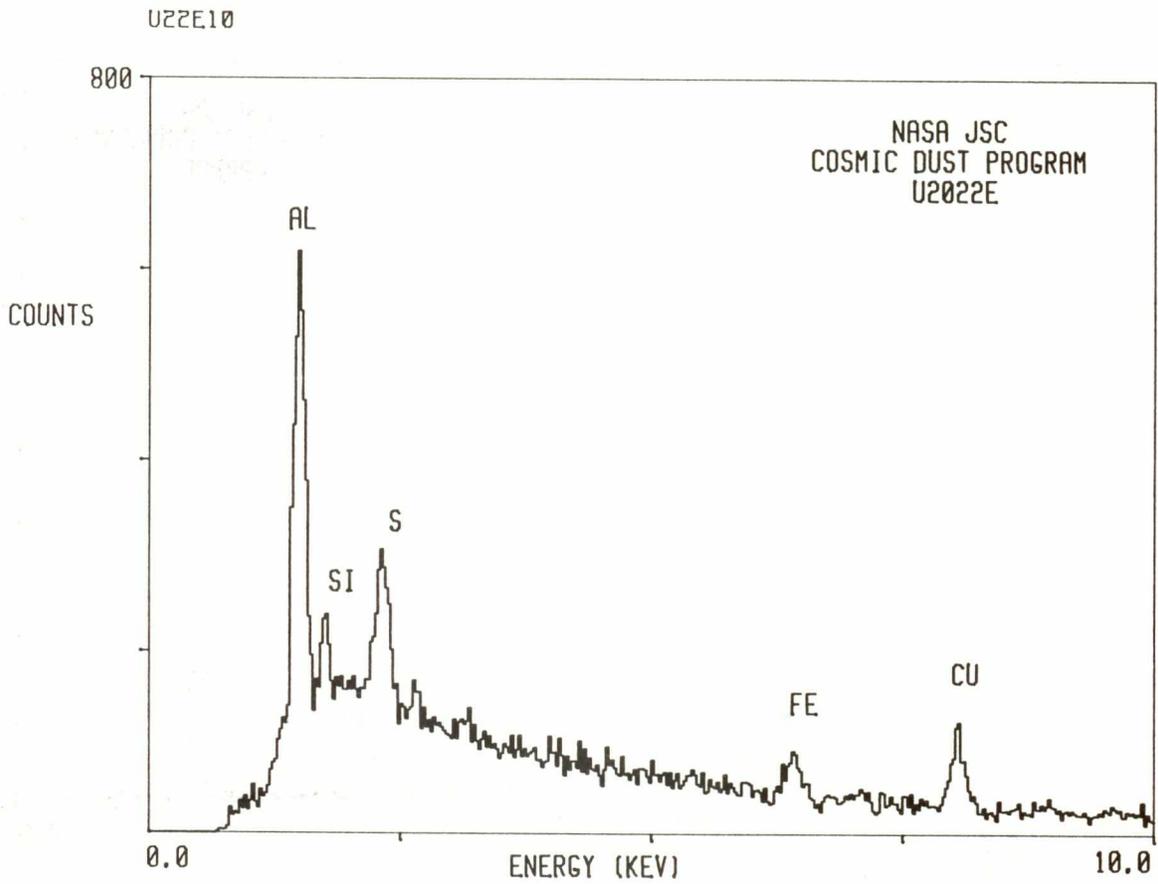
U2022 E 10



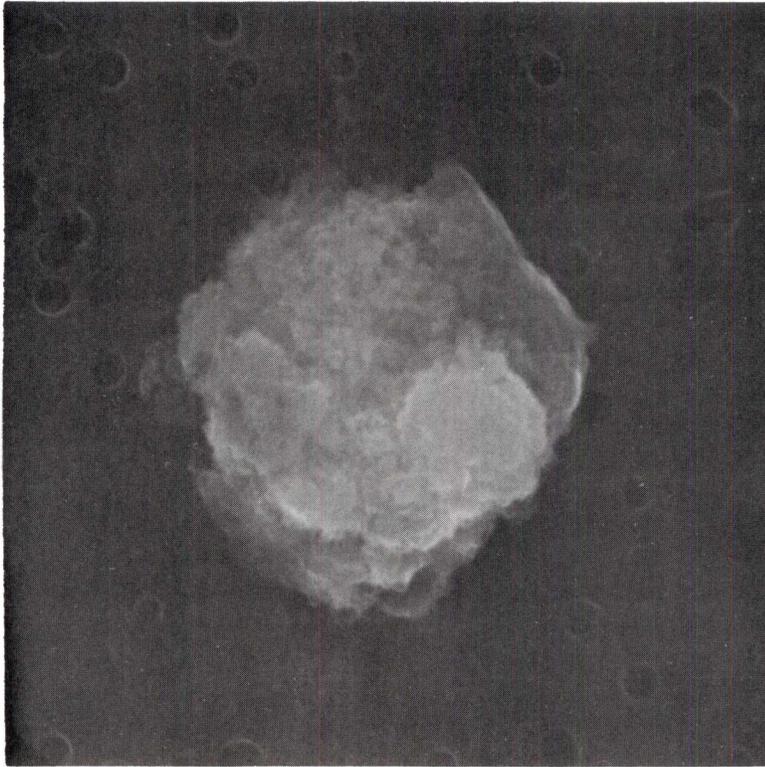
SIZE: 15x4
SHAPE: I
TRANS.: O
COLOR: Black
LUSTER: D
TYPE: TCA

COMMENTS:
Related to
U2022E11

S-85-42831



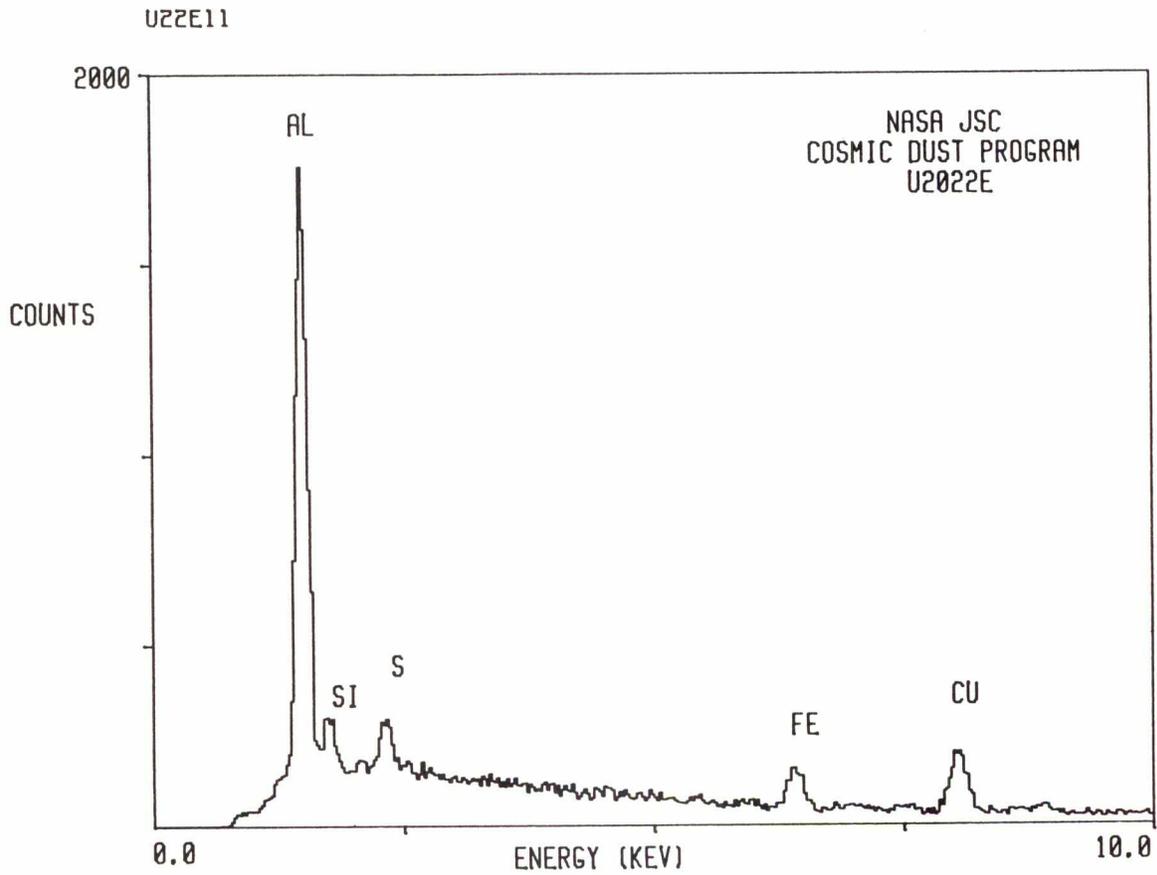
U2022 E 11



SIZE: 5
SHAPE: I
TRANS.: O
COLOR: Black
LUSTER: D
TYPE: TCA

COMMENTS:
Related to
U2022E10

S-85-42832



U2022 E 12



SIZE: 16x14

SHAPE: I

TRANS.: O

COLOR: Black

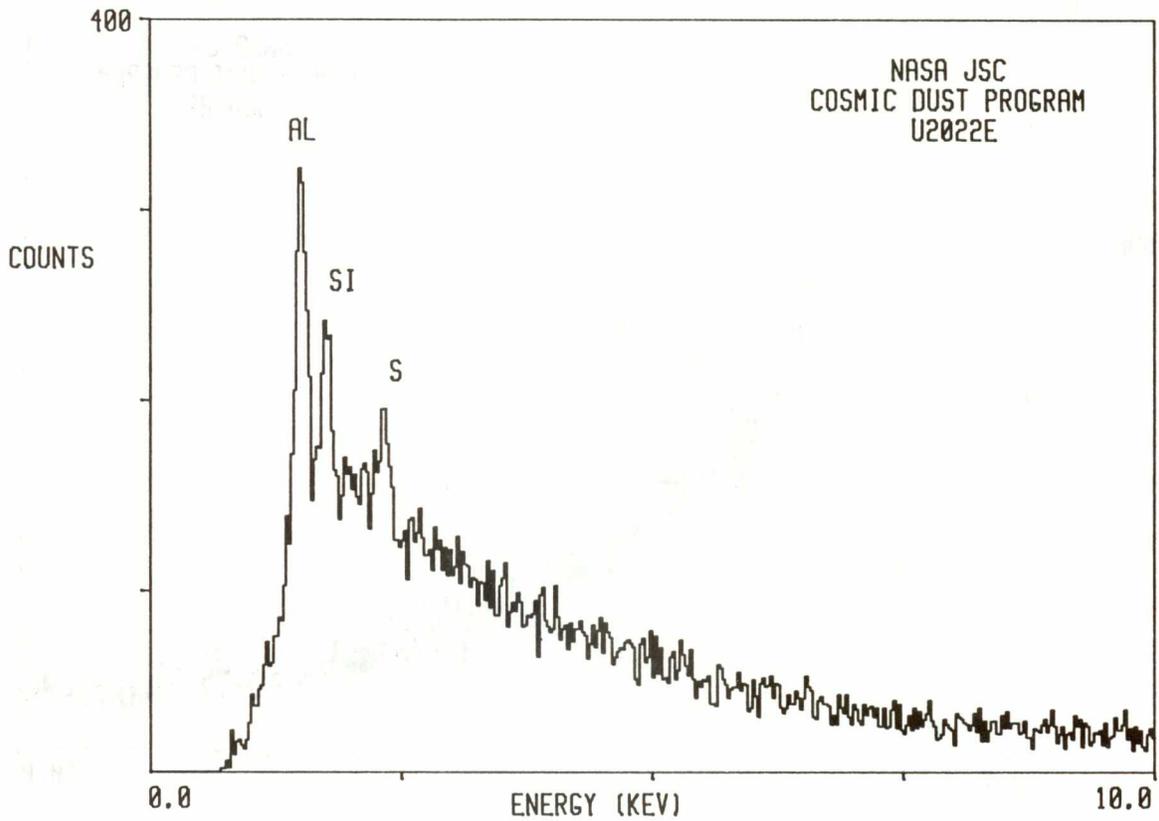
LUSTER: D

TYPE: TCA

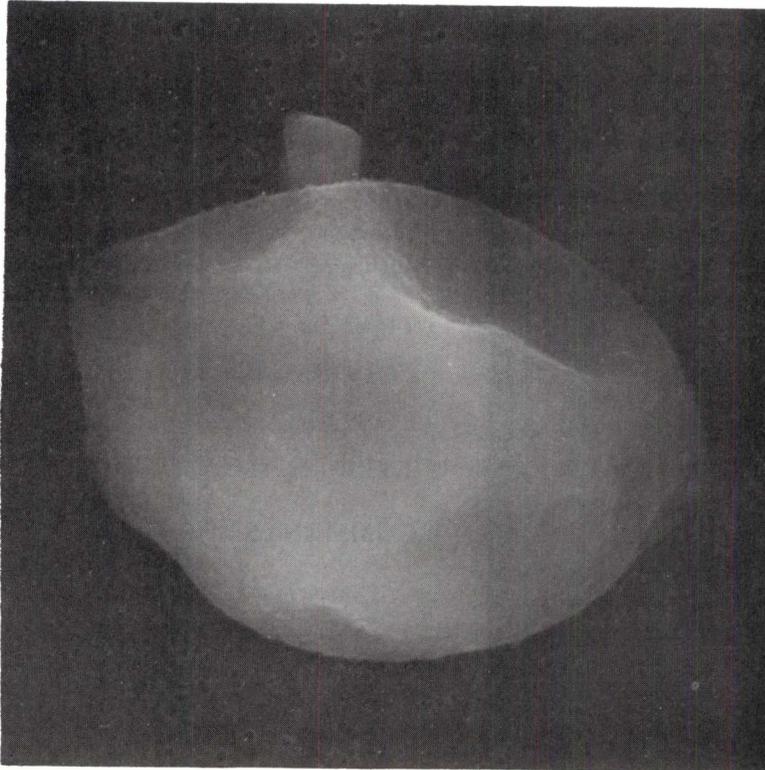
COMMENTS:

S-85-42833

U22E12



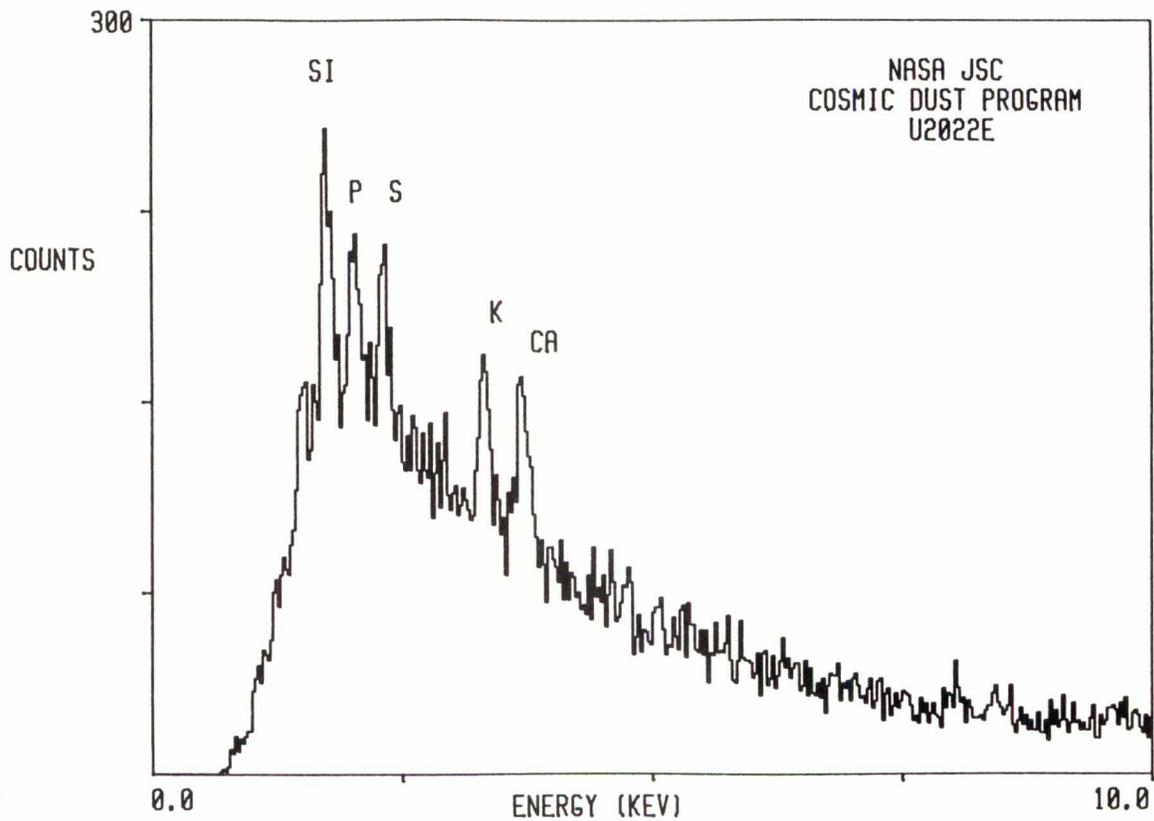
U2022 E 13



SIZE: 70x35
SHAPE: I
TRANS.: TL/T
COLOR: Colorless to Yellow
LUSTER: SV/V
TYPE: TCA?
COMMENTS:

S-85-42834

U22E13



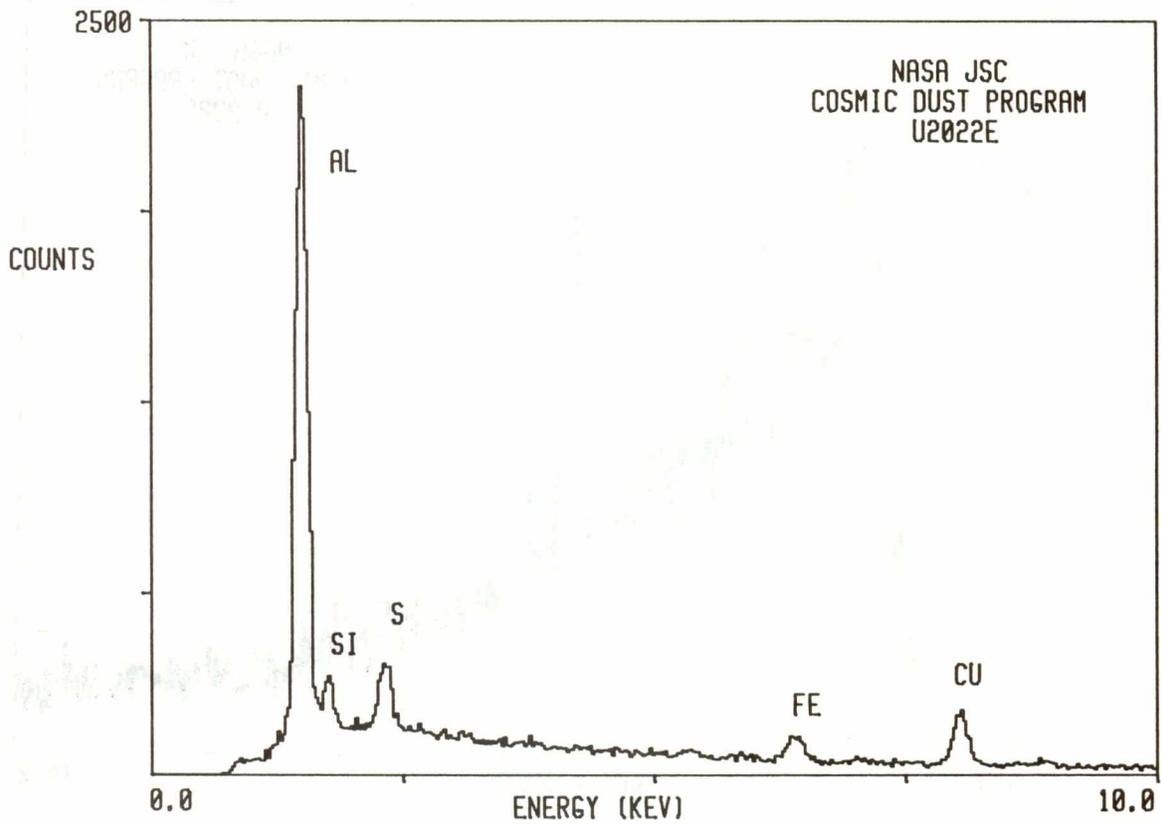
U2022 E 14



SIZE: 10x7
SHAPE: I
TRANS.: O
COLOR: Black
LUSTER: D
TYPE: TCA
COMMENTS:

S-85-42835

U22E11

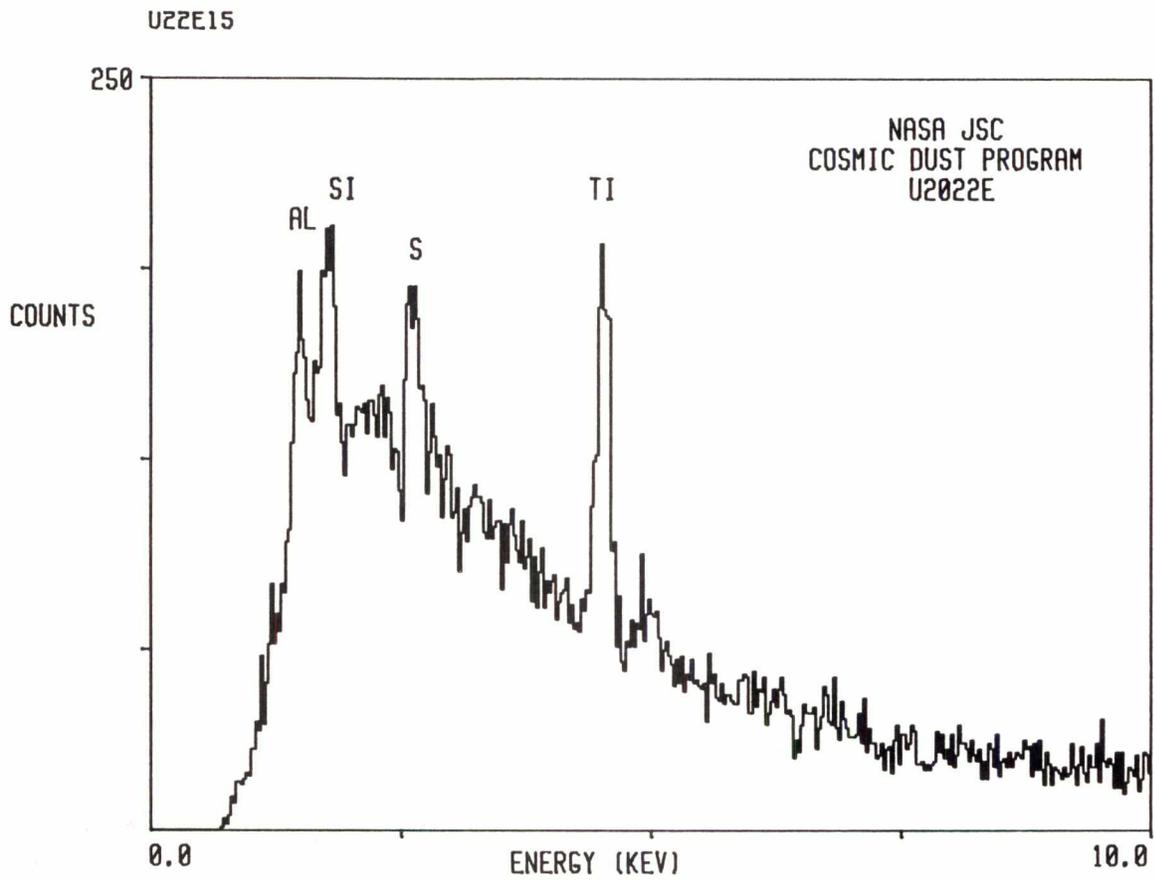


U2022 E 15

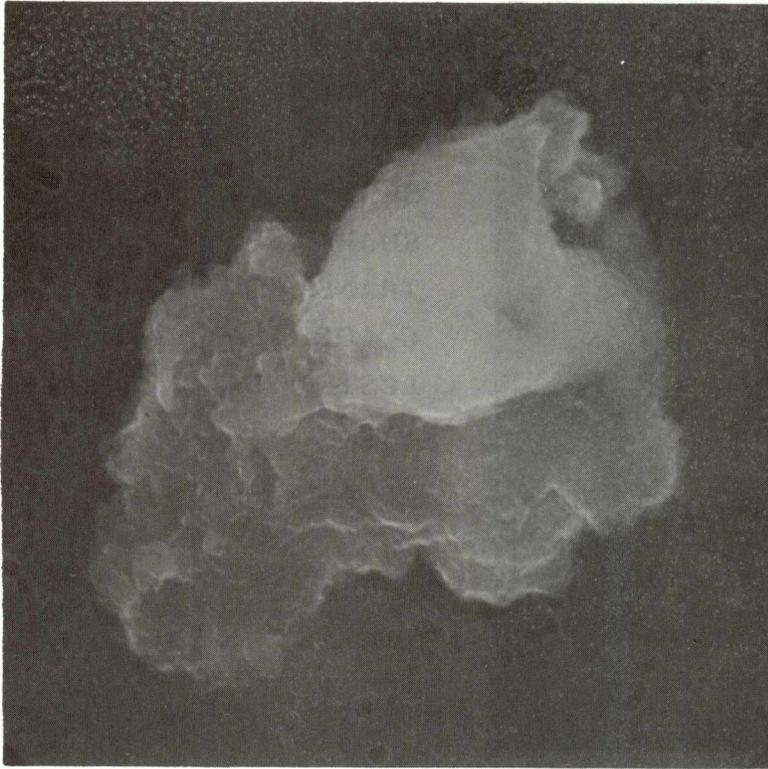


SIZE: 20x12
SHAPE: I
TRANS.: TL
COLOR: White
LUSTER: SV
TYPE: TCA
COMMENTS:

S-85-42836



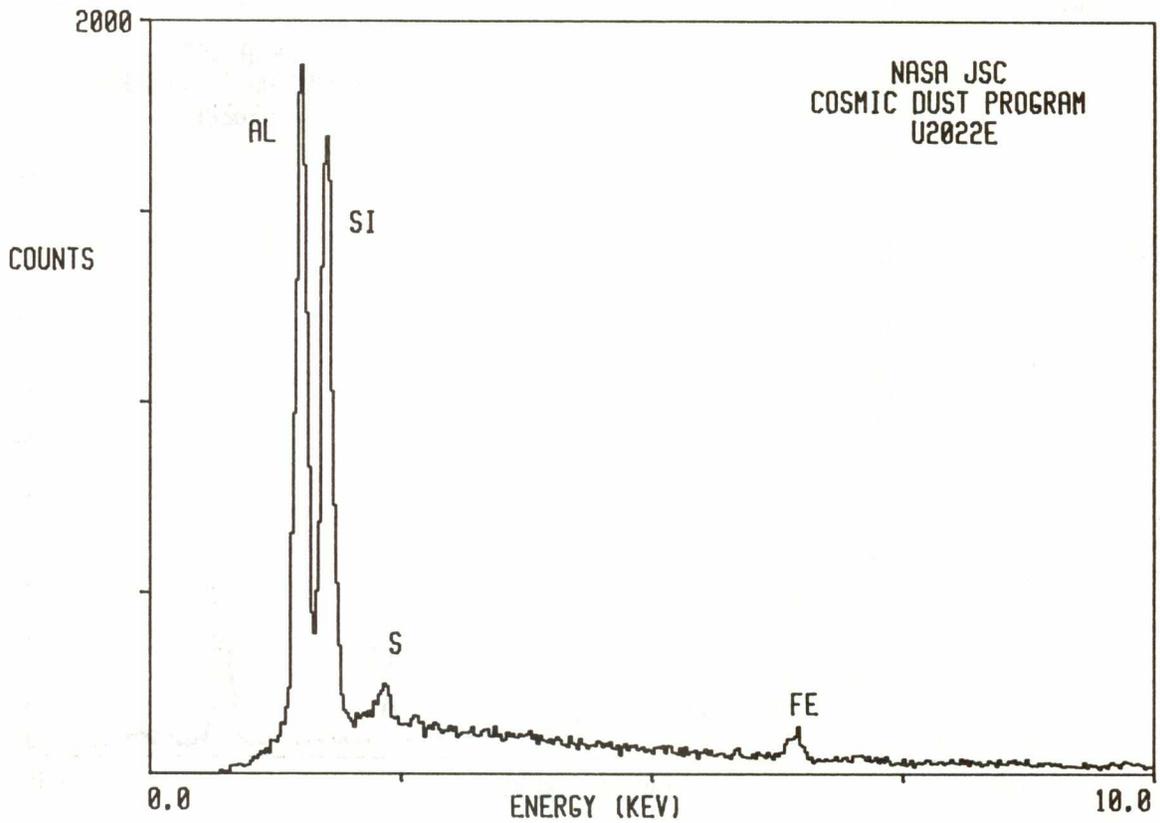
U2022 E 18



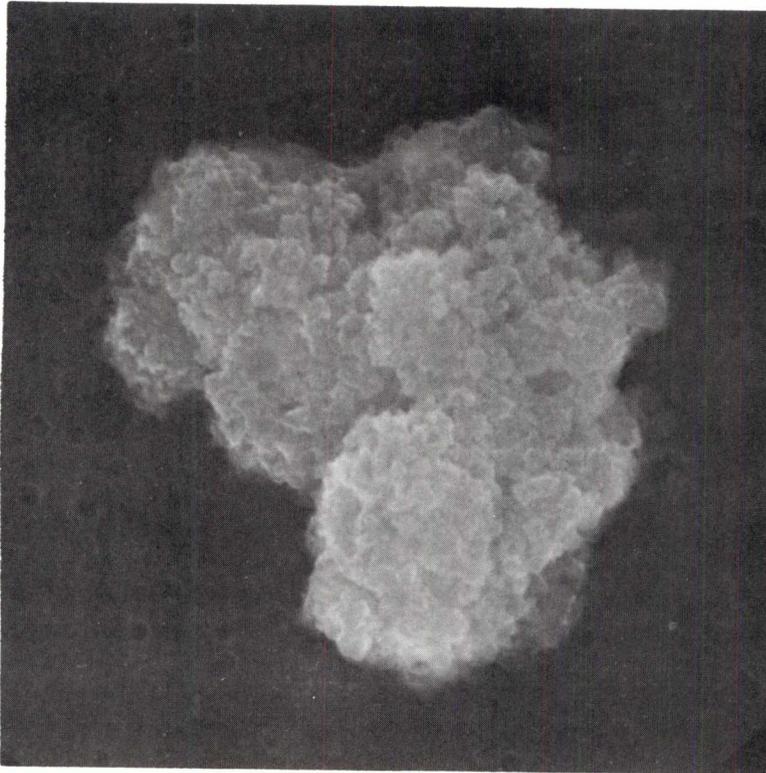
SIZE: 12
SHAPE: I
TRANS.: O
COLOR: Black
LUSTER: SM/D
TYPE: TCA
COMMENTS:

S-85-42839

U22E18

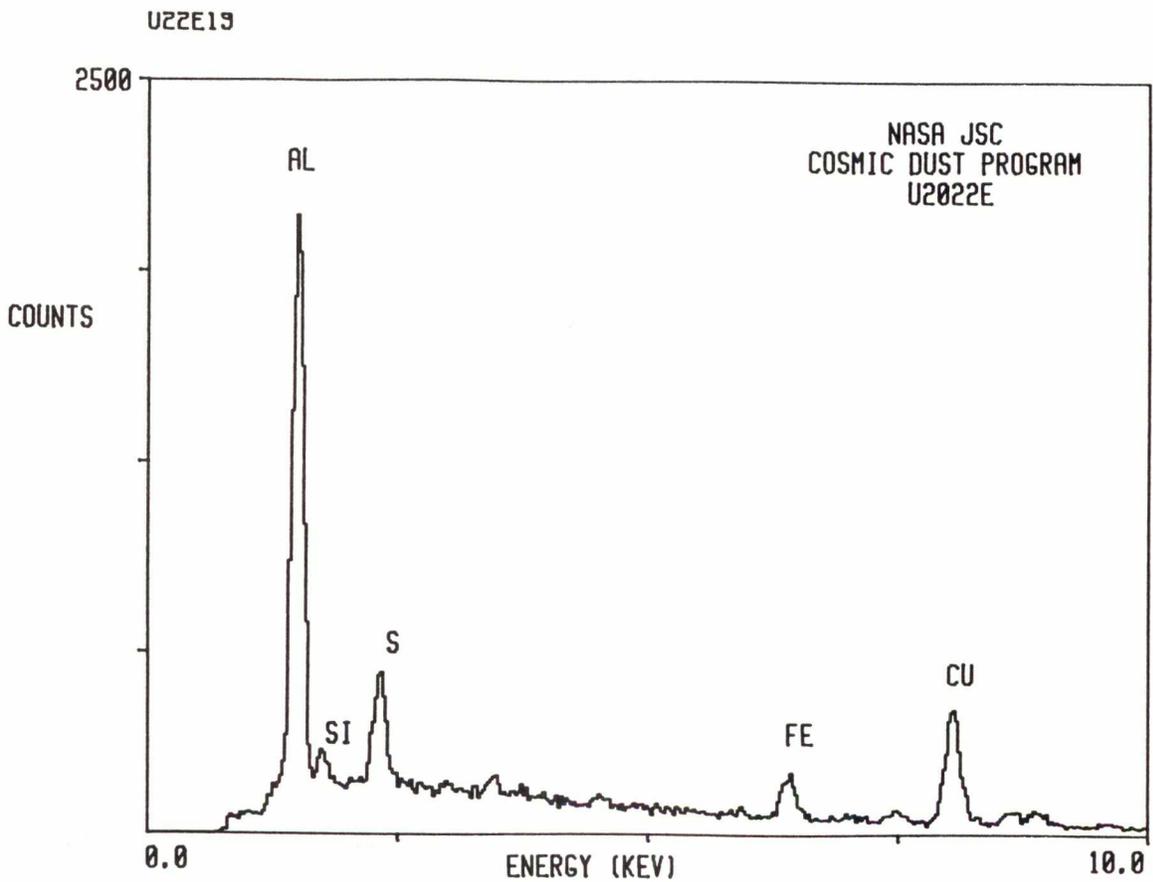


U2022 E 19

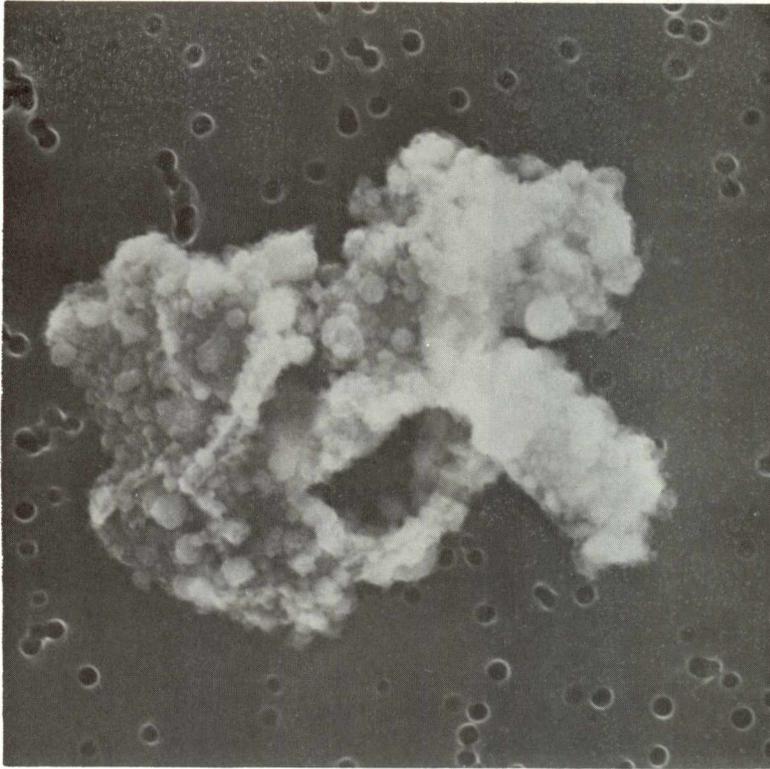


SIZE: 14
SHAPE: I
TRANS.: O
COLOR: Brown to Black
LUSTER: D
TYPE: TCA
COMMENTS:

S-85-42840



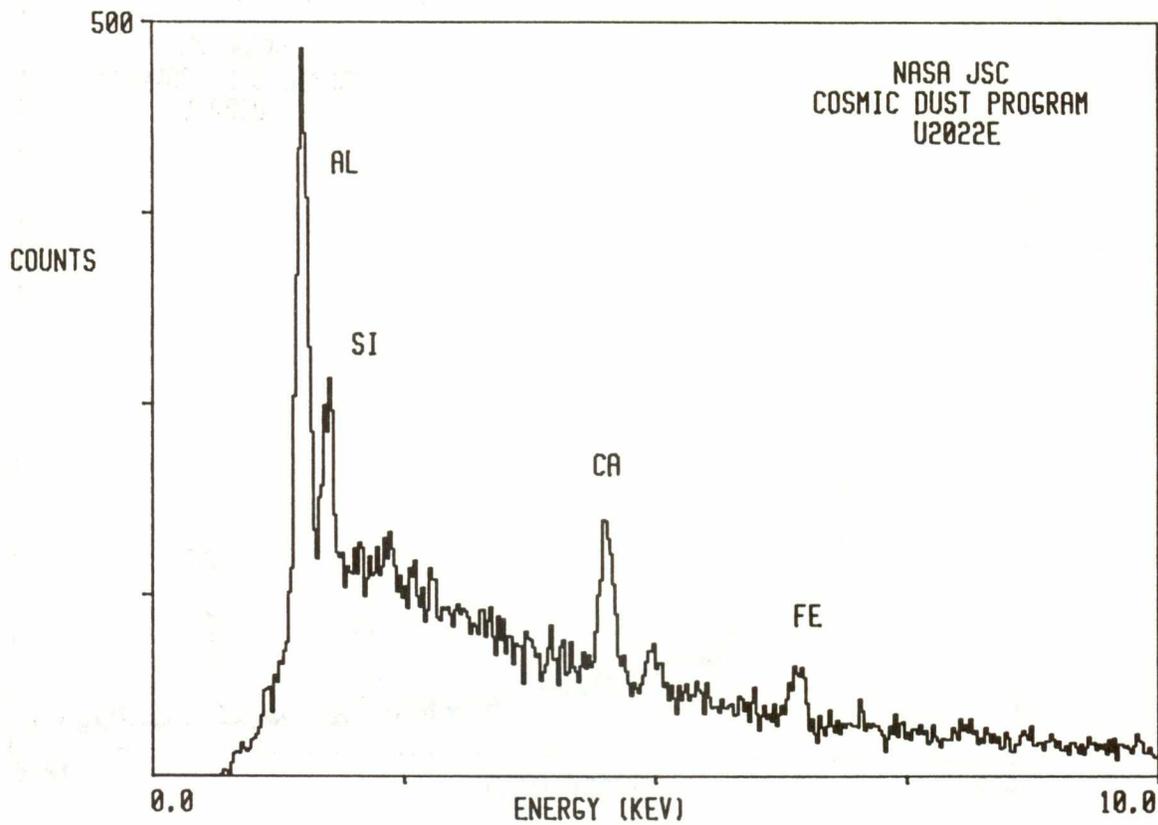
U2022 E 26



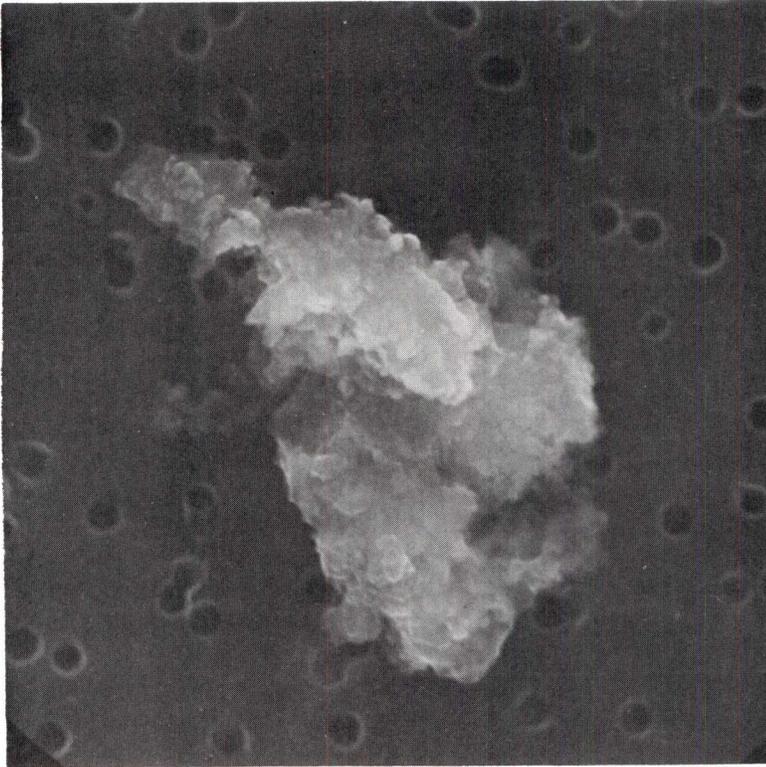
SIZE: 10x8
SHAPE: I
TRANS.: O
COLOR: Black
LUSTER: D
TYPE: TCA
COMMENTS:

S-85-42847

U22E26



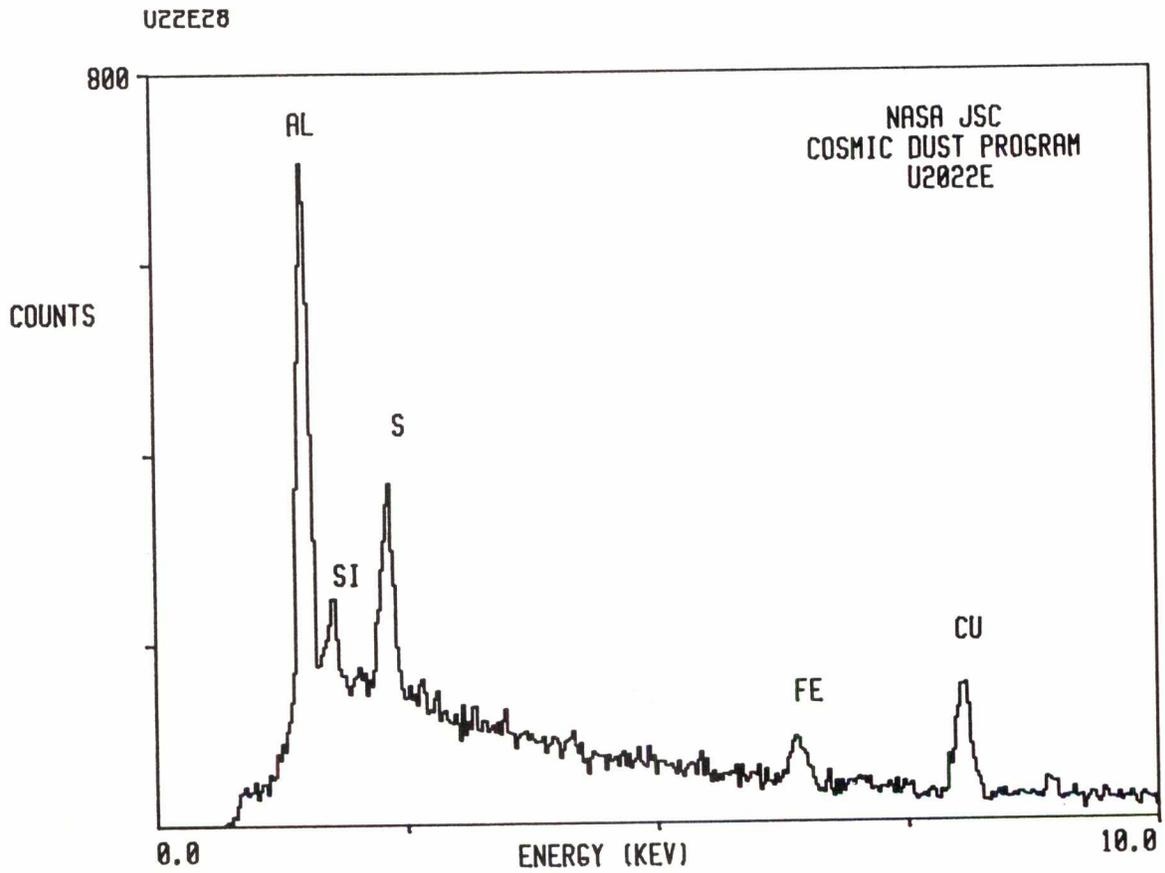
U2022 E 28



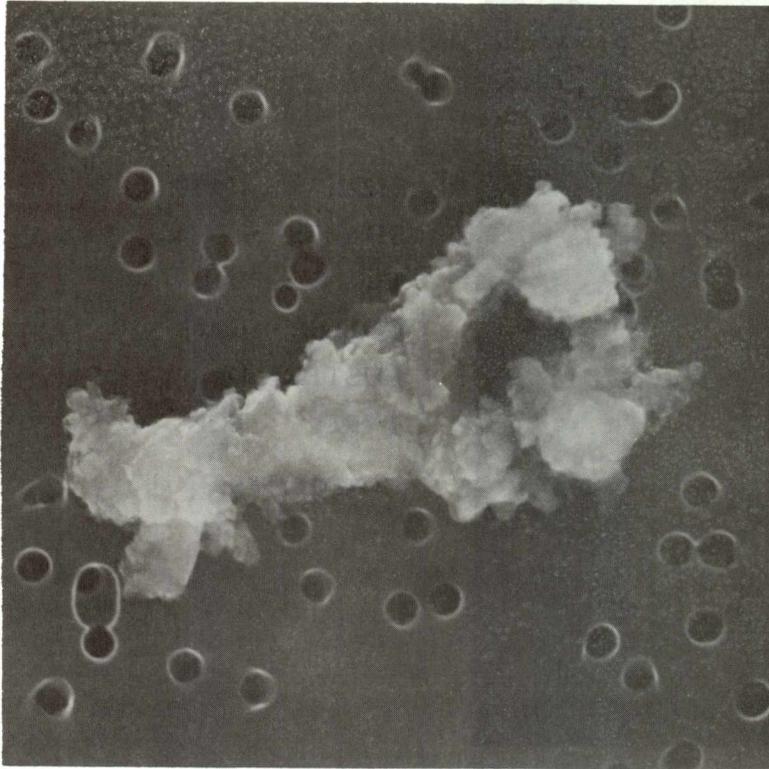
SIZE: 7
SHAPE: I
TRANS.: O
COLOR: Black
LUSTER: D
TYPE: TCA

COMMENTS:
May be related to
U2022E10, 11 and
29

S-85-42849



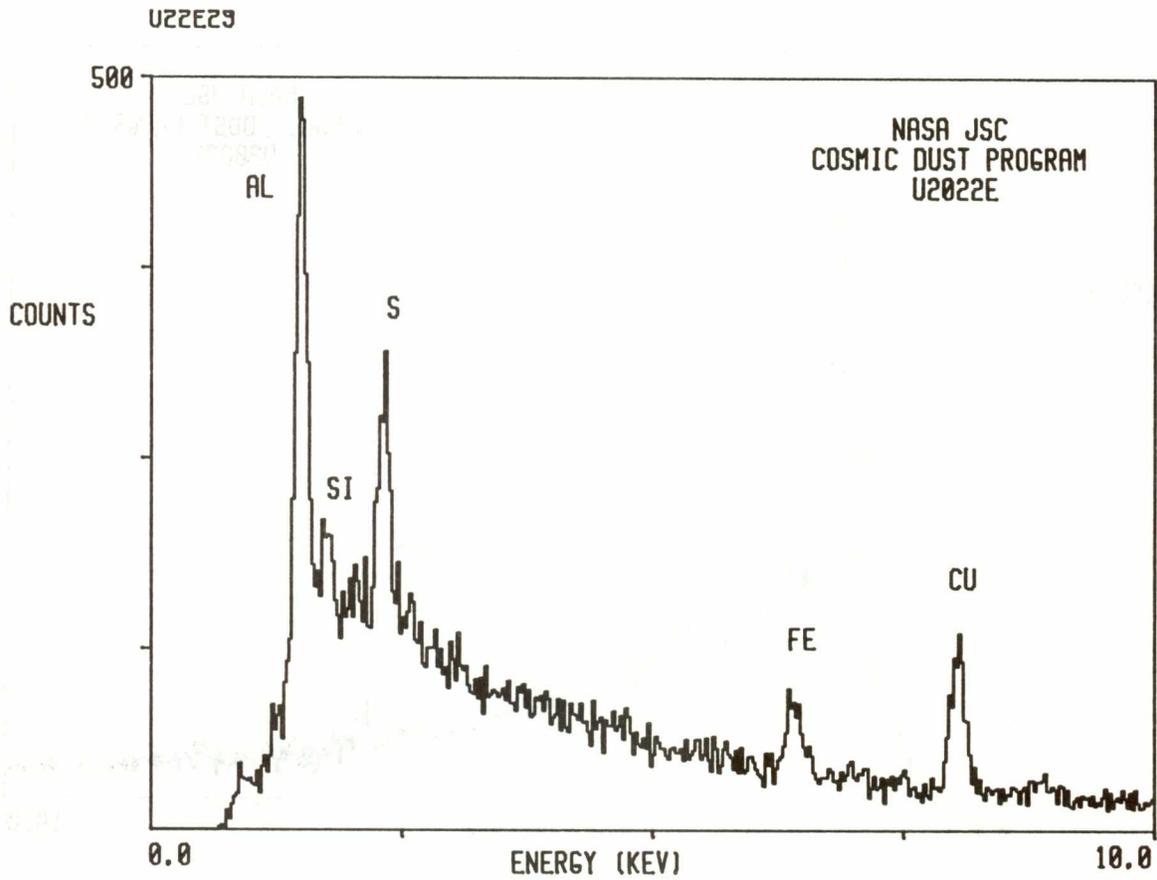
U2022 E 29



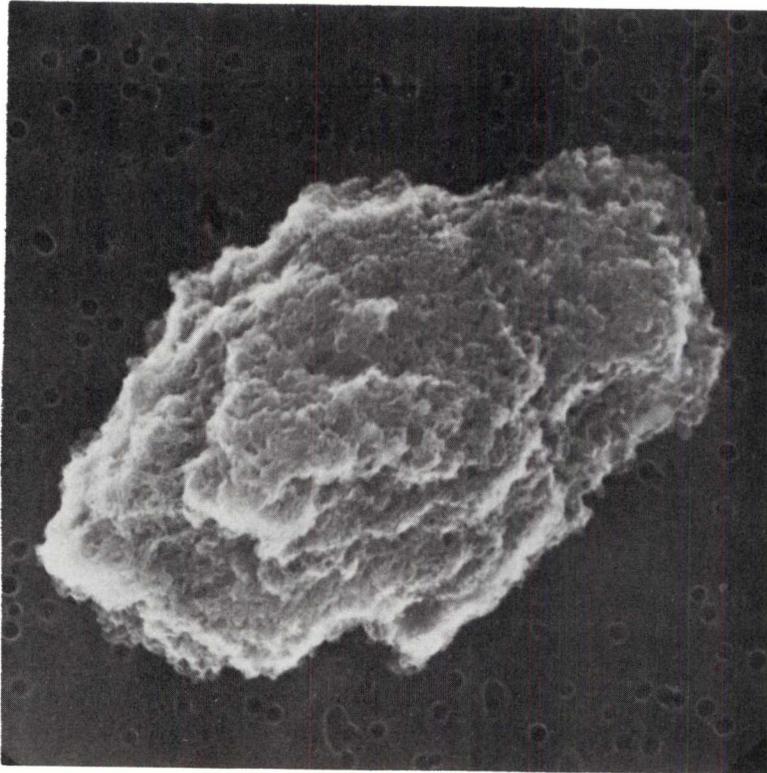
SIZE: 8
SHAPE: I
TRANS.: O
COLOR: Black
LUSTER: D
TYPE: TCA

COMMENTS:
May be related to
U2022E10, 11 and
28

S-85-42850



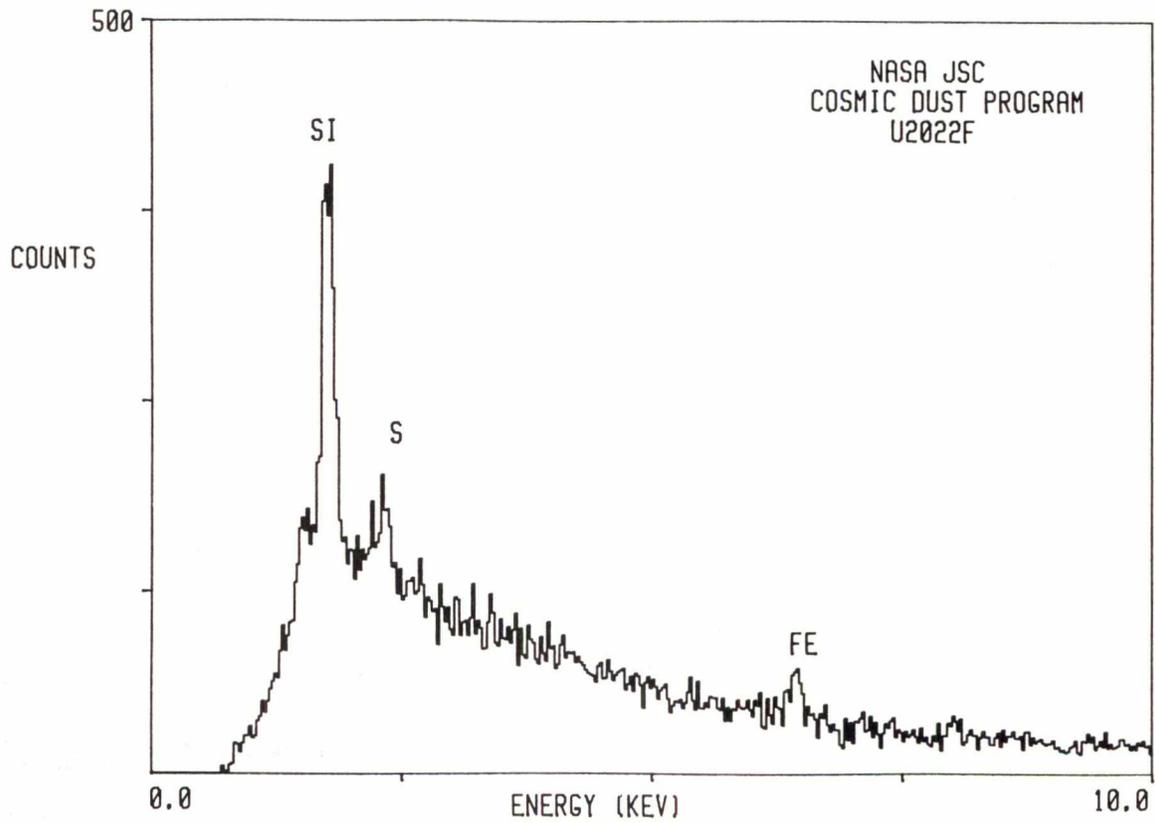
U2022 F 1



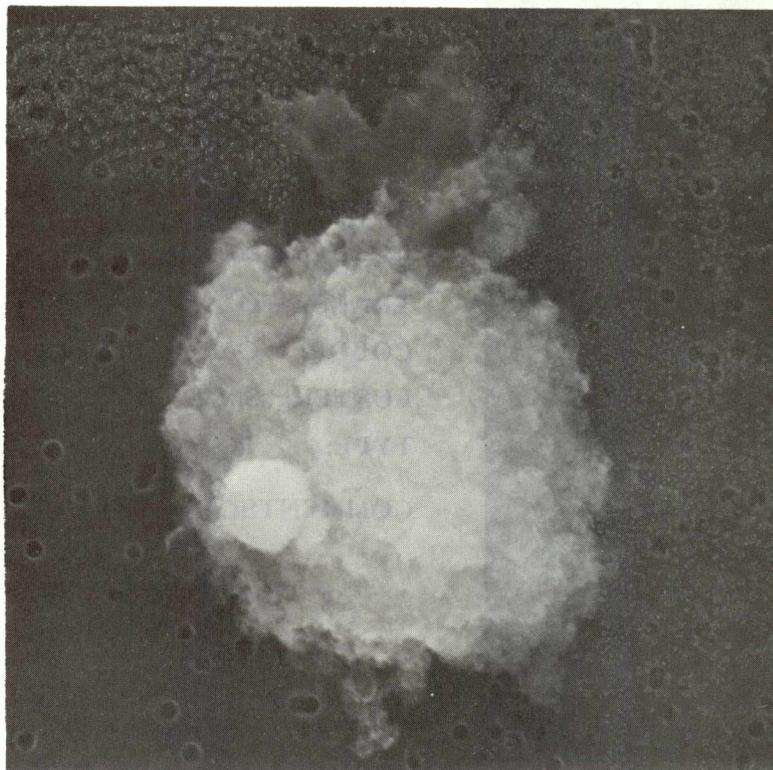
SIZE: 15x10
SHAPE: I
TRANS.: O
COLOR: Black
LUSTER: D
TYPE: TCN
COMMENTS:

S-85-42858

U22F1

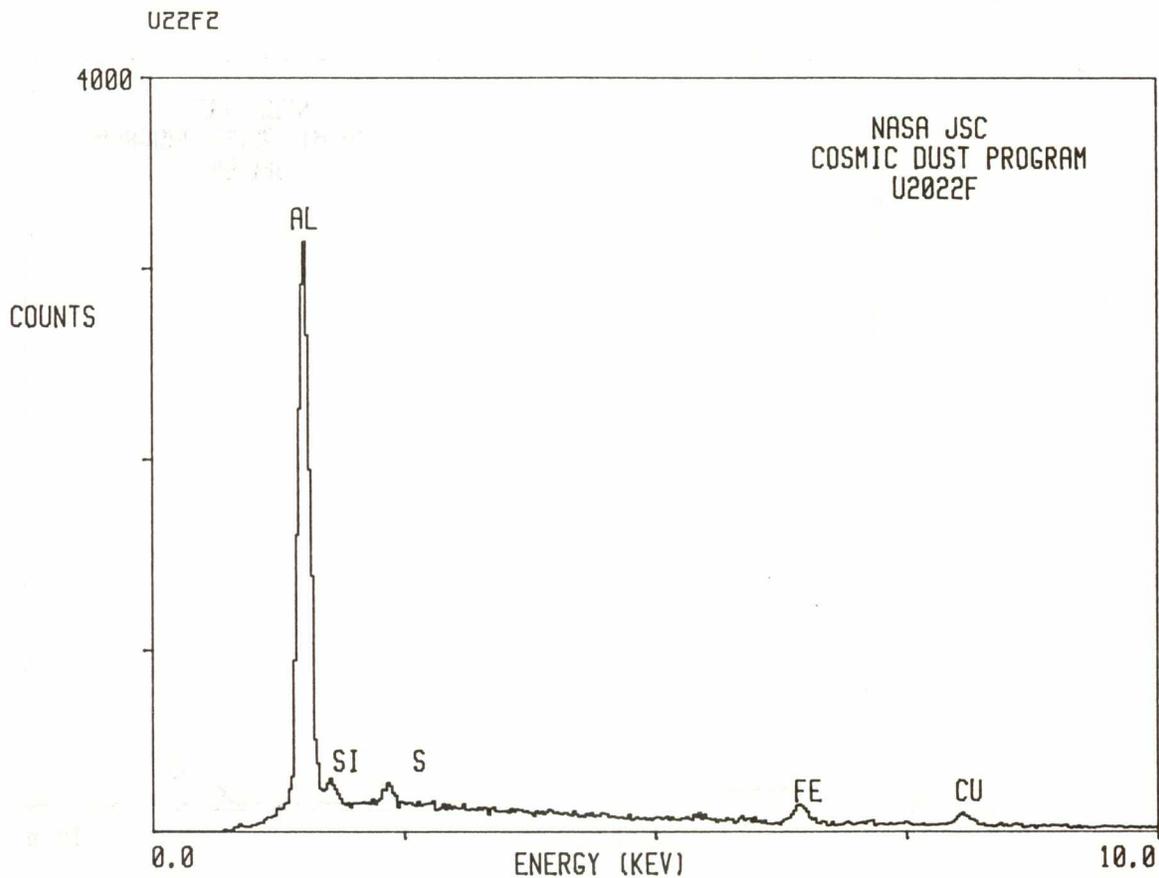


U2022 F 2

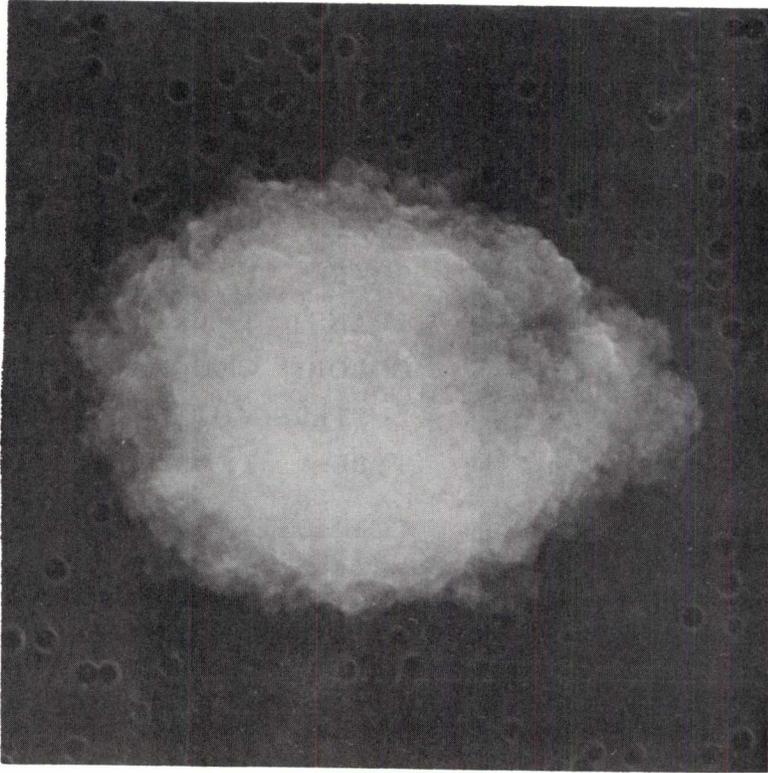


SIZE: 10
SHAPE: I
TRANS.: T/O
COLOR: Clorless to Black
LUSTER: V/D
TYPE: TCA
COMMENTS:

S-85-42859

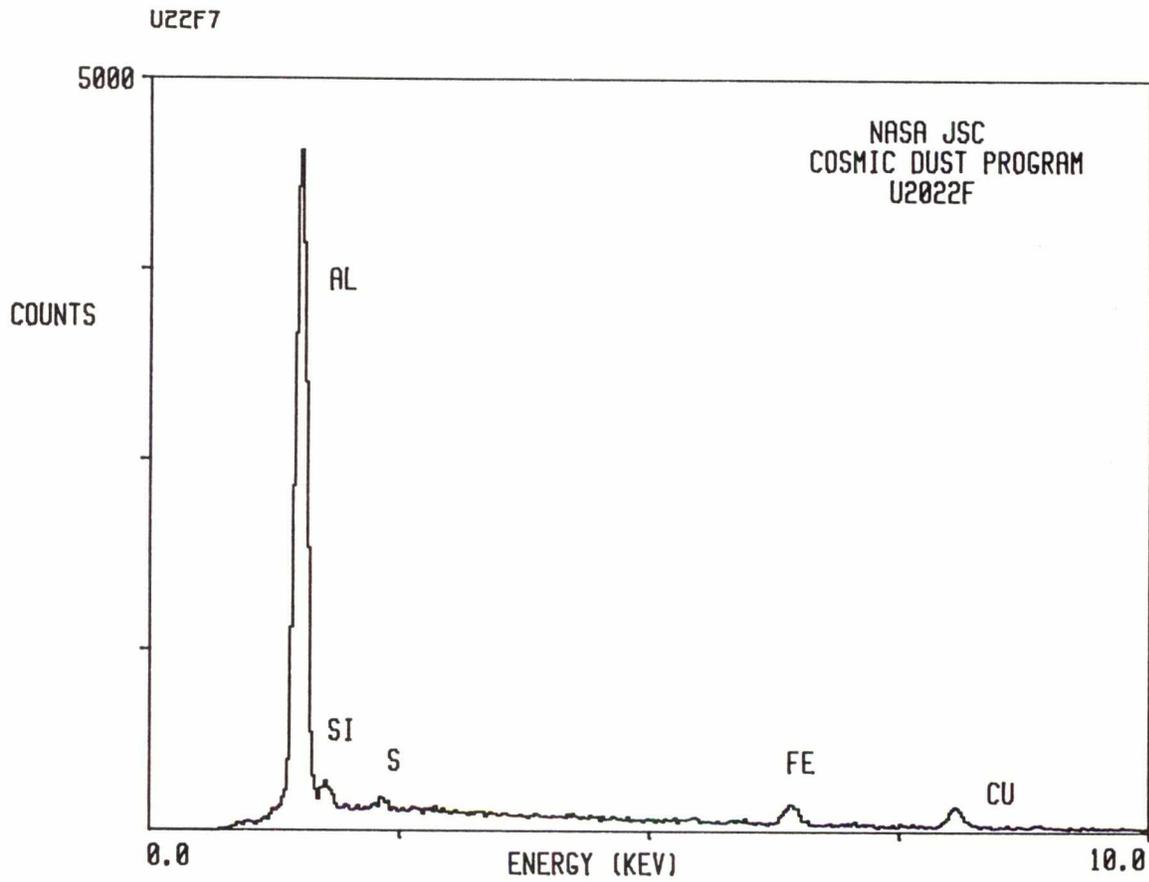


U2022 F 7

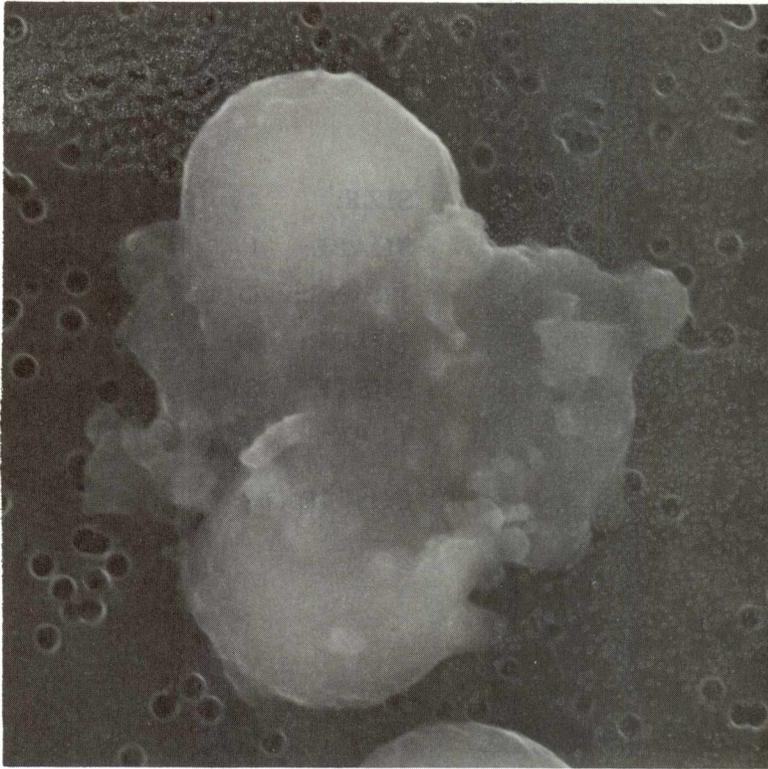


SIZE: 11x9
SHAPE: S
TRANS.: O
COLOR: Gold to Brown
LUSTER: SM/D
TYPE: TCA
COMMENTS:

S-85-42853



U2022 F 11

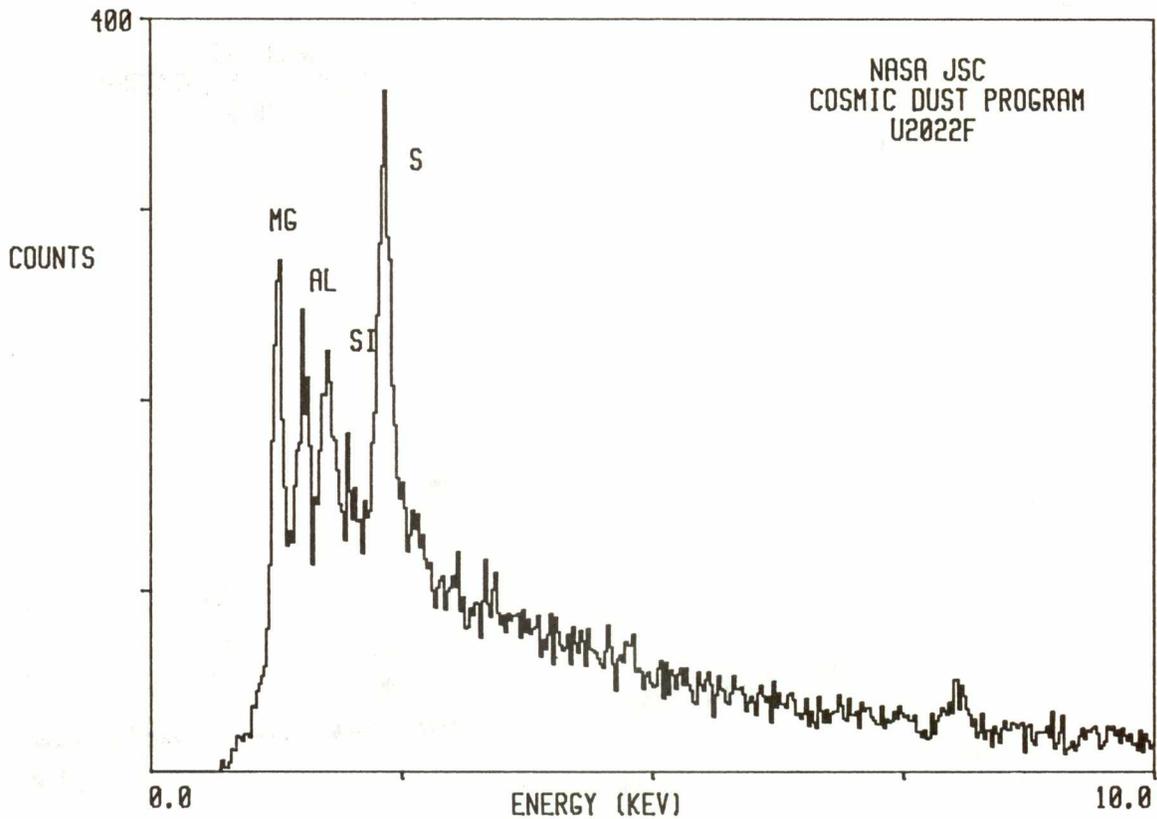


SIZE: 20x16
SHAPE: I/S
TRANS.: TL/O
COLOR: White to Brown
LUSTER: SV/D
TYPE: TCA?

COMMENTS:
May be related to
U2022F19

S-85-42857

U22F11



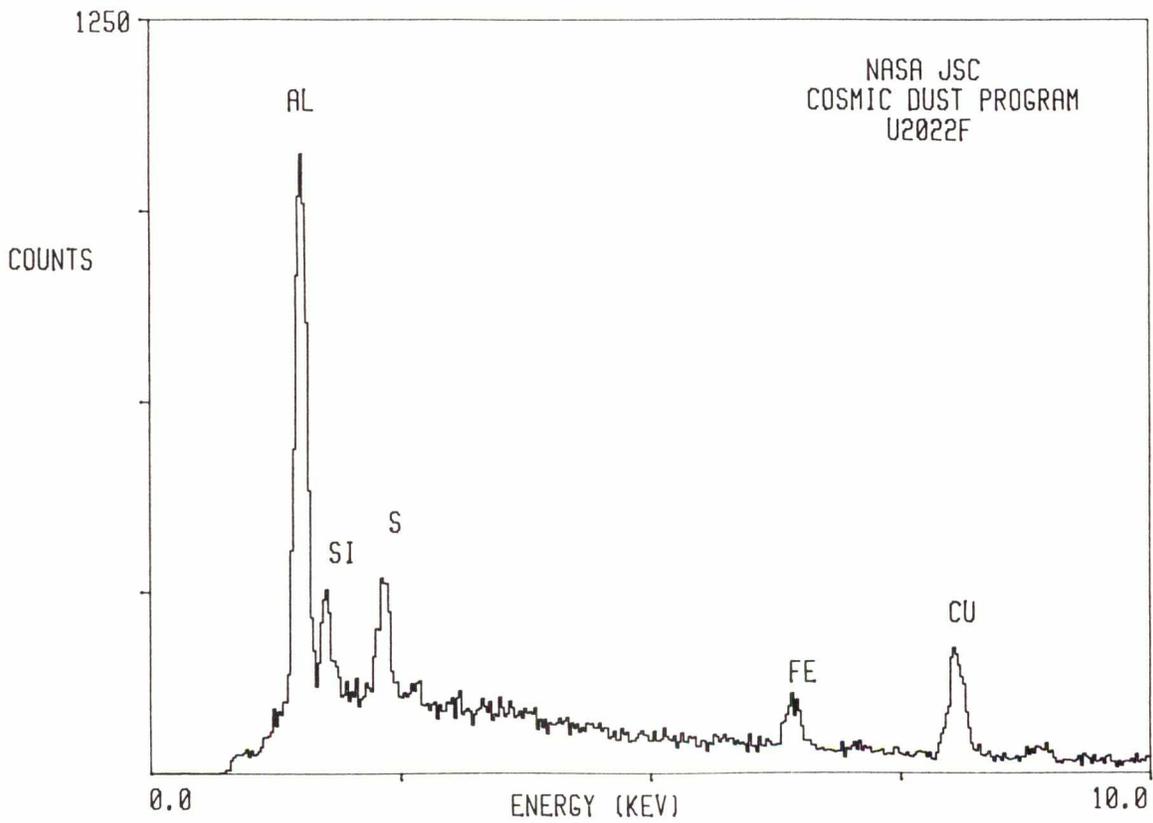
U2022 F 16



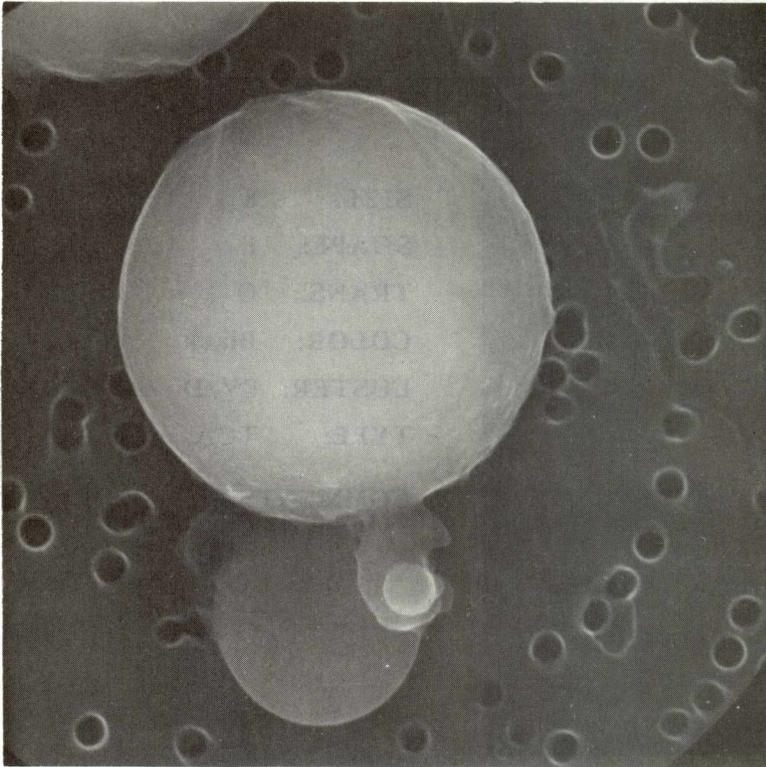
SIZE: 15x12
SHAPE: I
TRANS.: O/TL
COLOR: White to Black
LUSTER: SV/D
TYPE: TCA
COMMENTS:

S-85-42870

U22F16



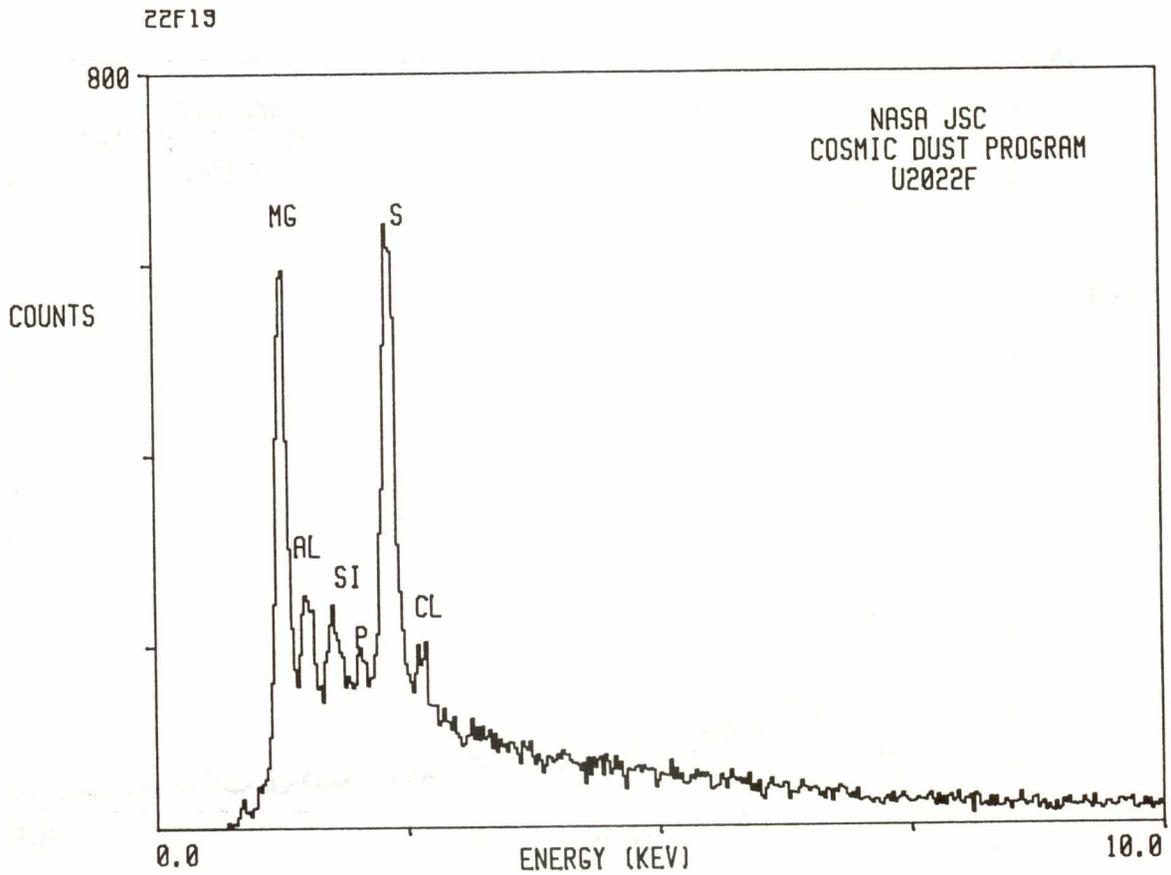
U2022 F 19



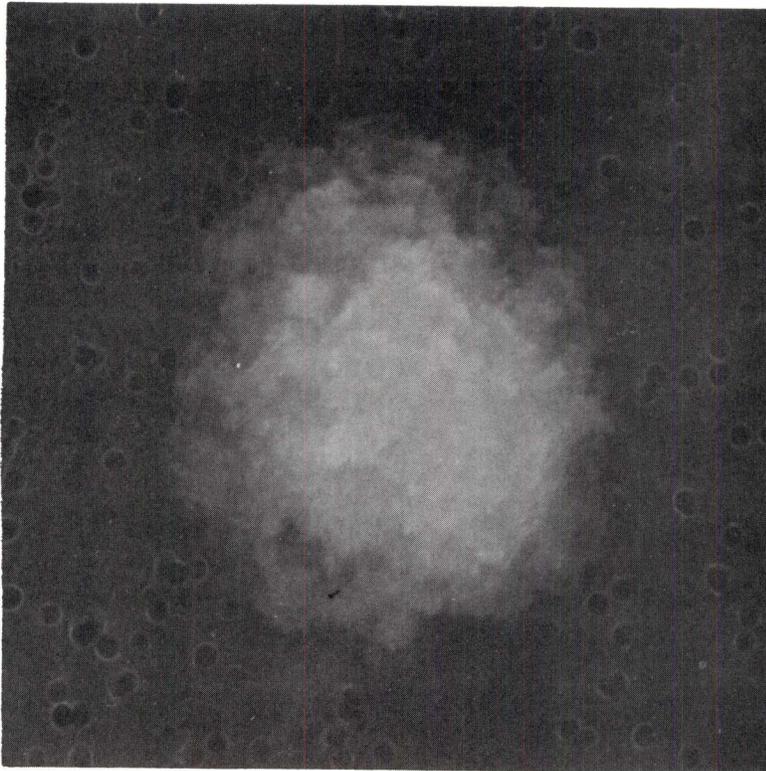
SIZE: 12
SHAPE: S
TRANS.: TL/O
COLOR: White to Brown
LUSTER: SV
TYPE: TCA?

COMMENTS:
May be related to
U2022F11

S-85-42863

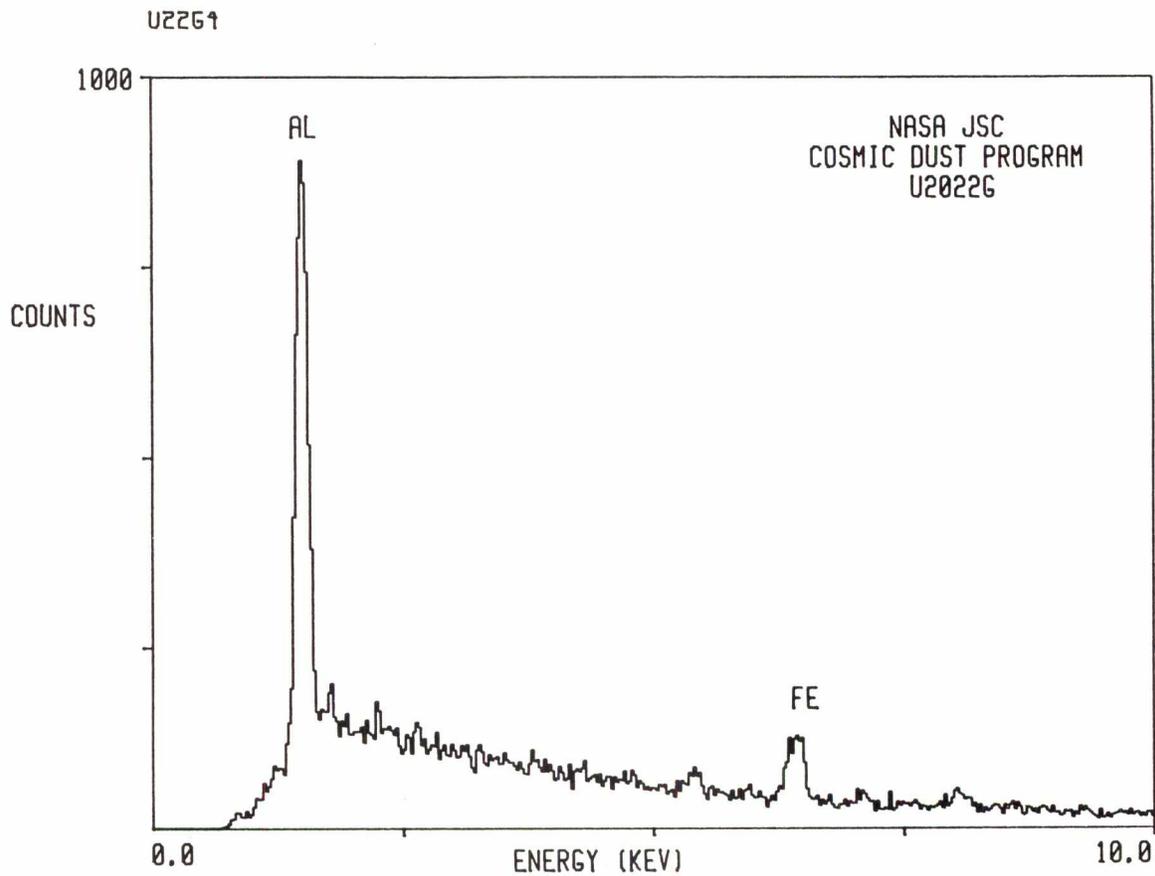


U2022 G 4

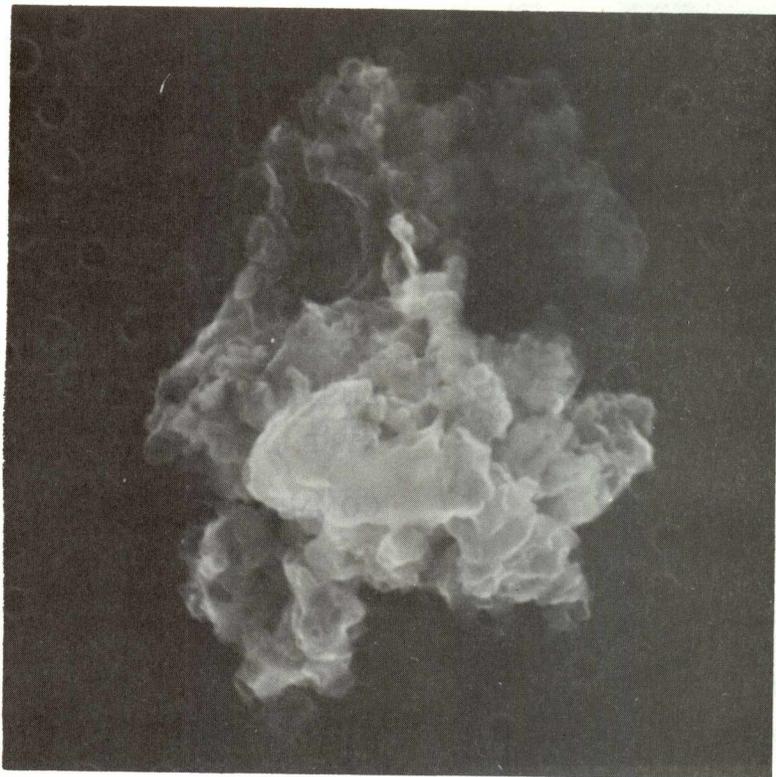


SIZE: 8
SHAPE: I
TRANS.: O
COLOR: Black
LUSTER: SV/D
TYPE: TCA
COMMENTS:

S-85-42879



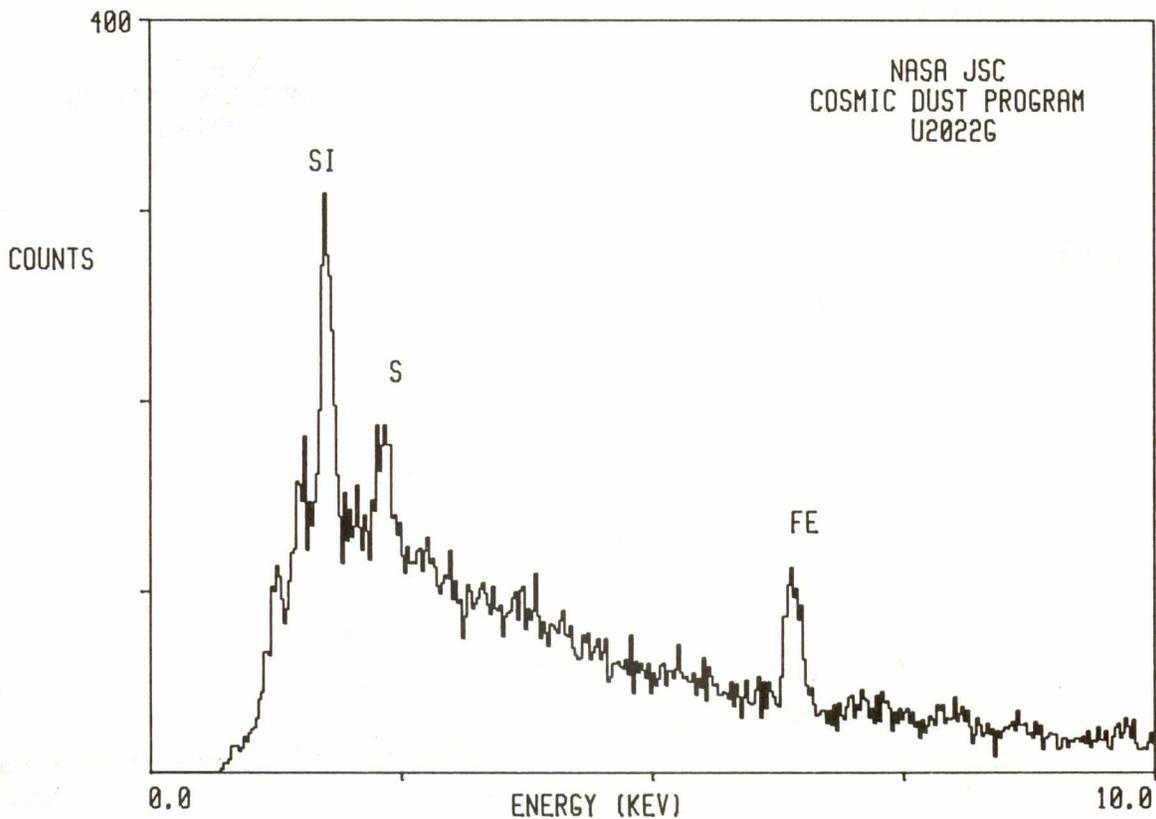
U2022 G 5



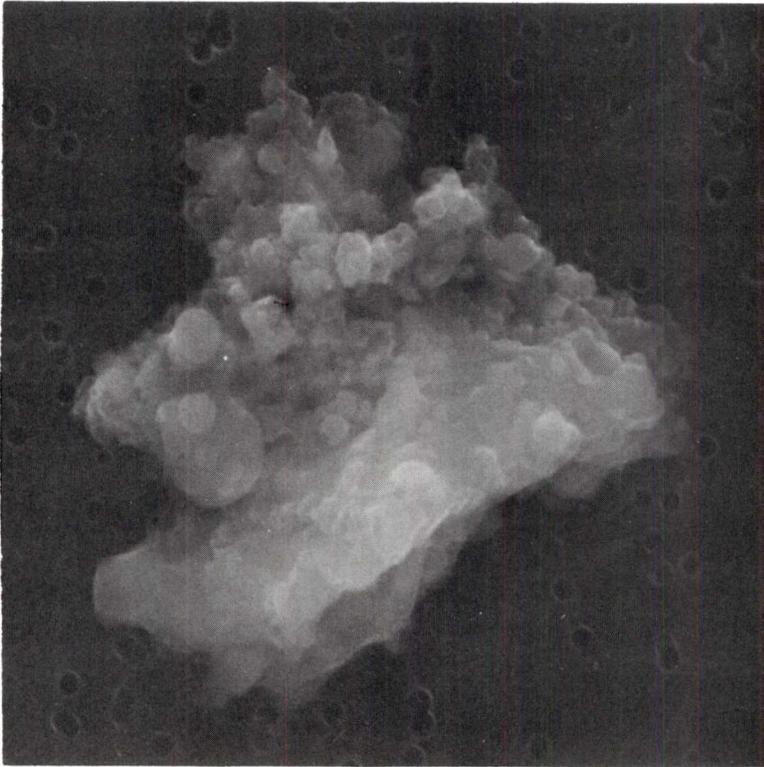
SIZE: 7
SHAPE: I
TRANS.: O
COLOR: Gold to Black
LUSTER: SM/D
TYPE: TCN
COMMENTS:

S-85-42880

U22265



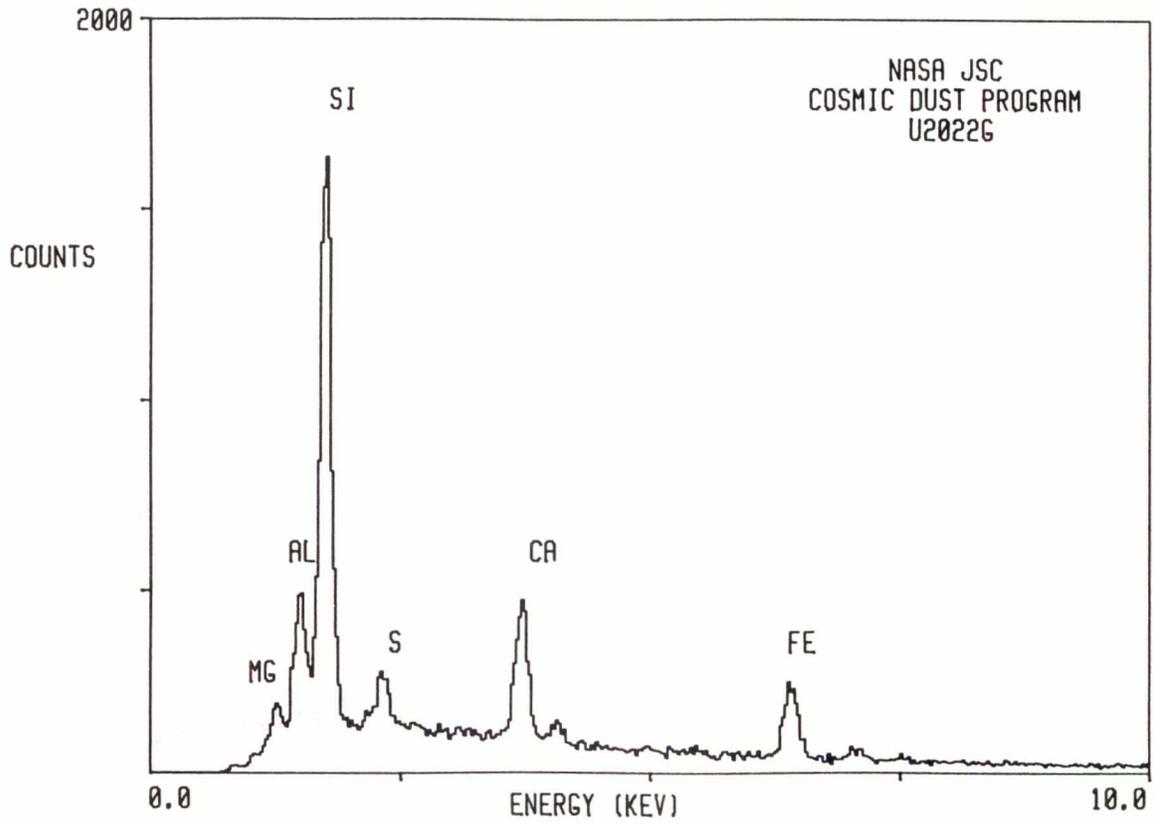
U2022 G 15



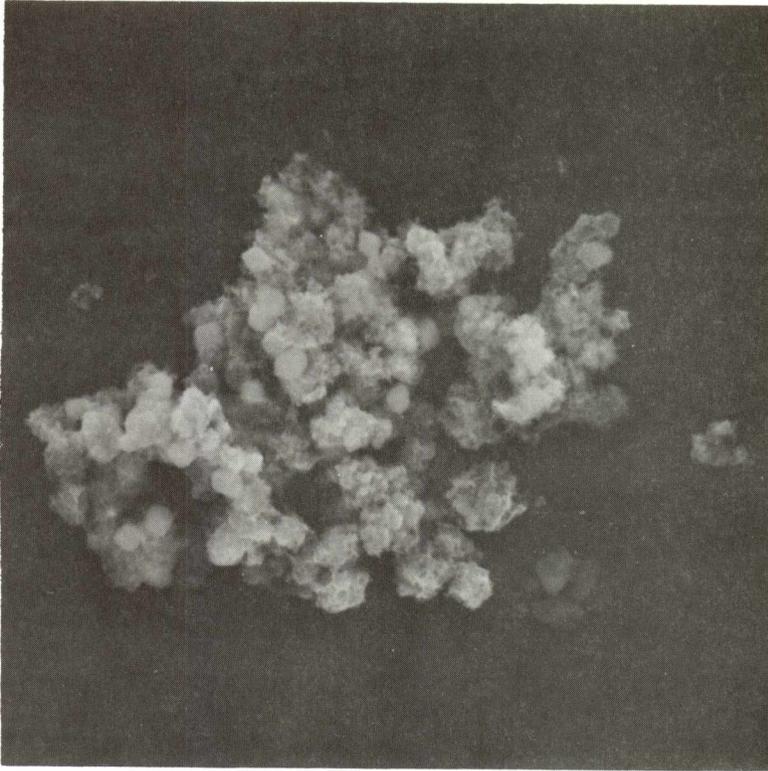
SIZE: 12
SHAPE: I
TRANS.: O
COLOR: Yellow to Brown
LUSTER: V/D
TYPE: TCN?
COMMENTS:

S-85-42885

U22G15



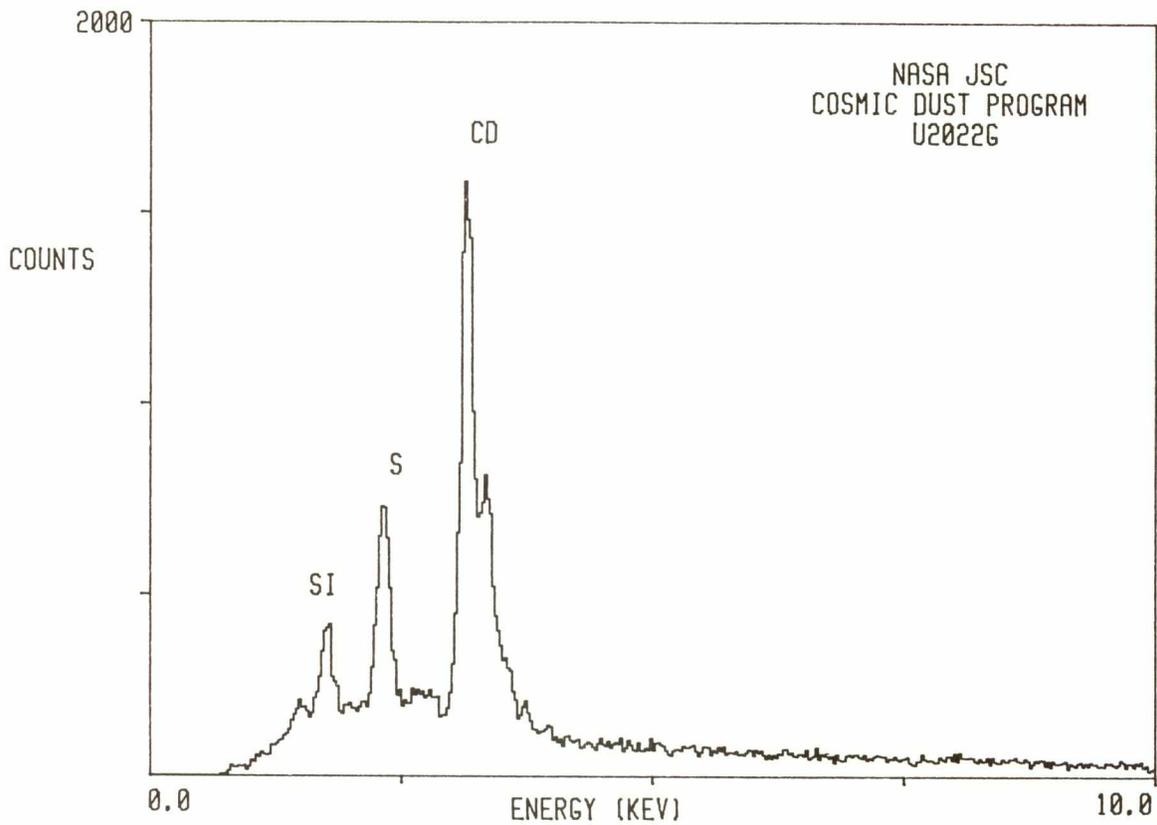
U2022 G 23

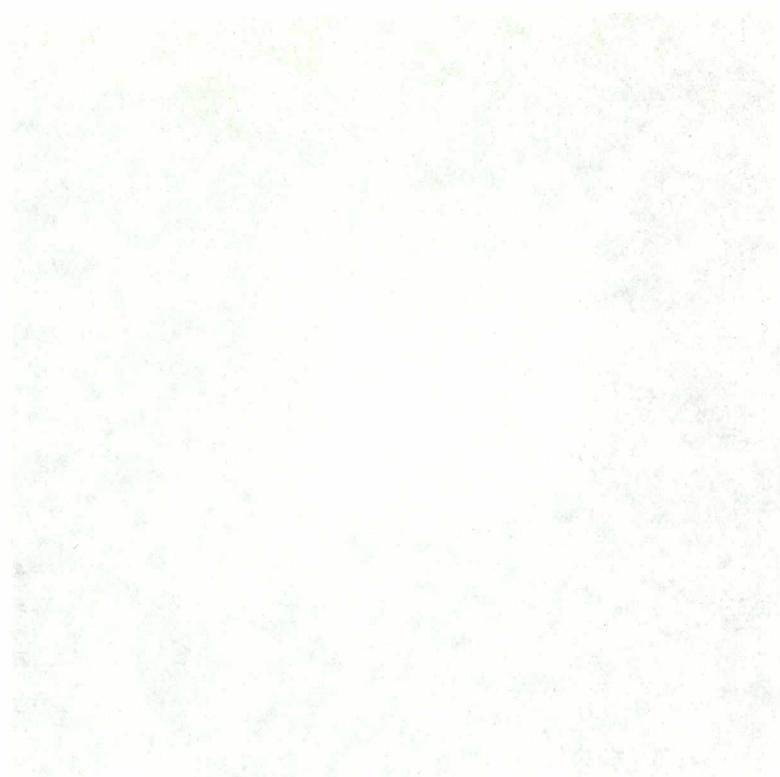


SIZE: 60x50
SHAPE: I
TRANS.: TL
COLOR: Yellow
LUSTER: P/D
TYPE: TCA
COMMENTS:

S-85-42894

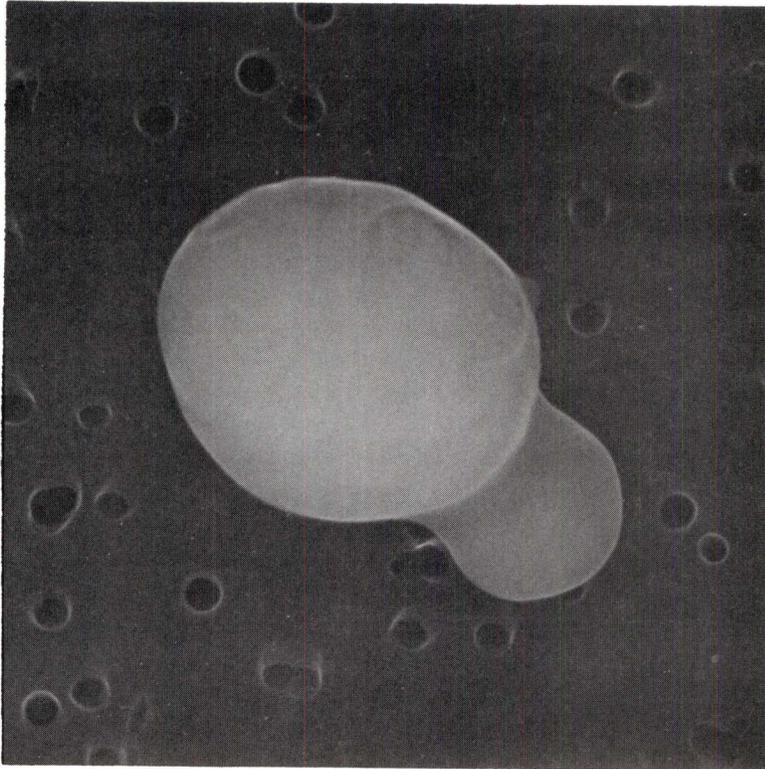
U22G23





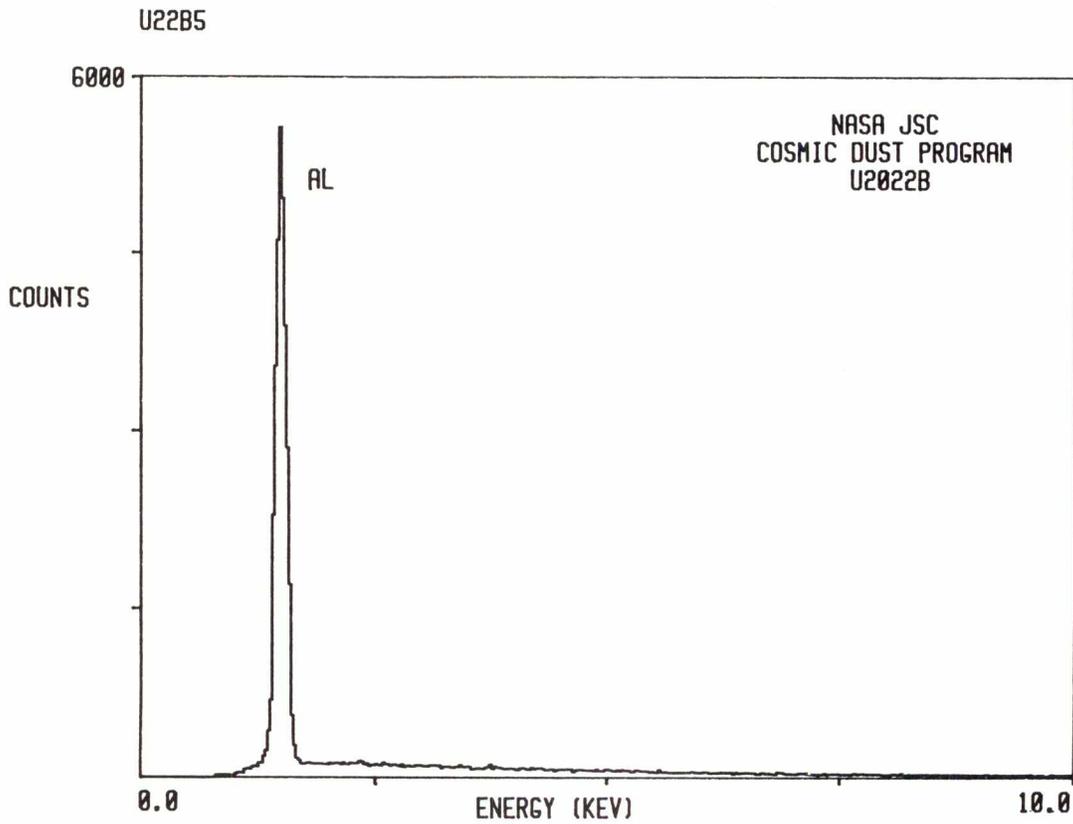
ALUMINUM OXIDE SPHERES

U2022 B 5

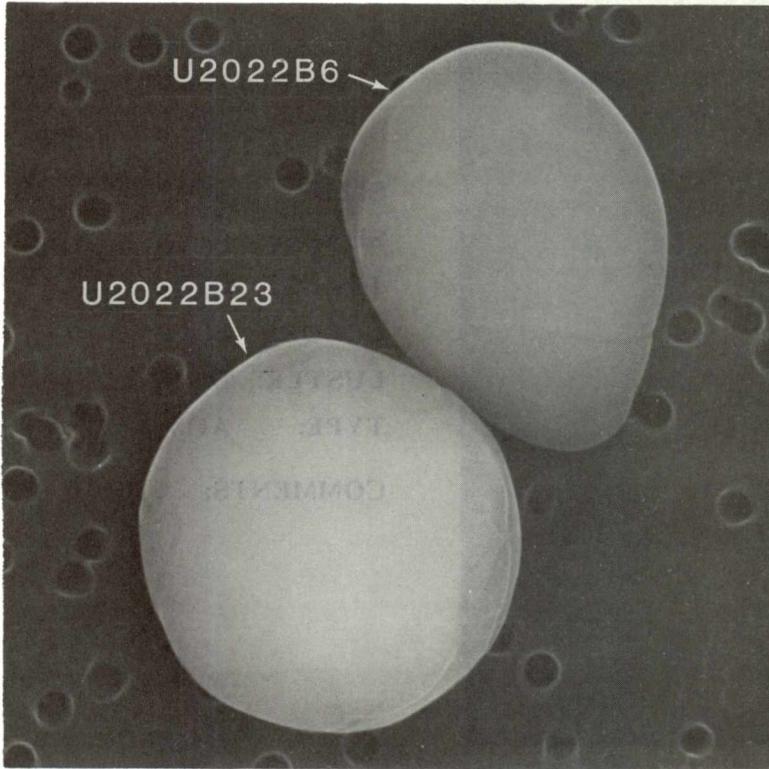


SIZE: 7
SHAPE: S
TRANS.: T
COLOR: Colorless
LUSTER: V
TYPE: AOS
COMMENTS:

S-85-42769



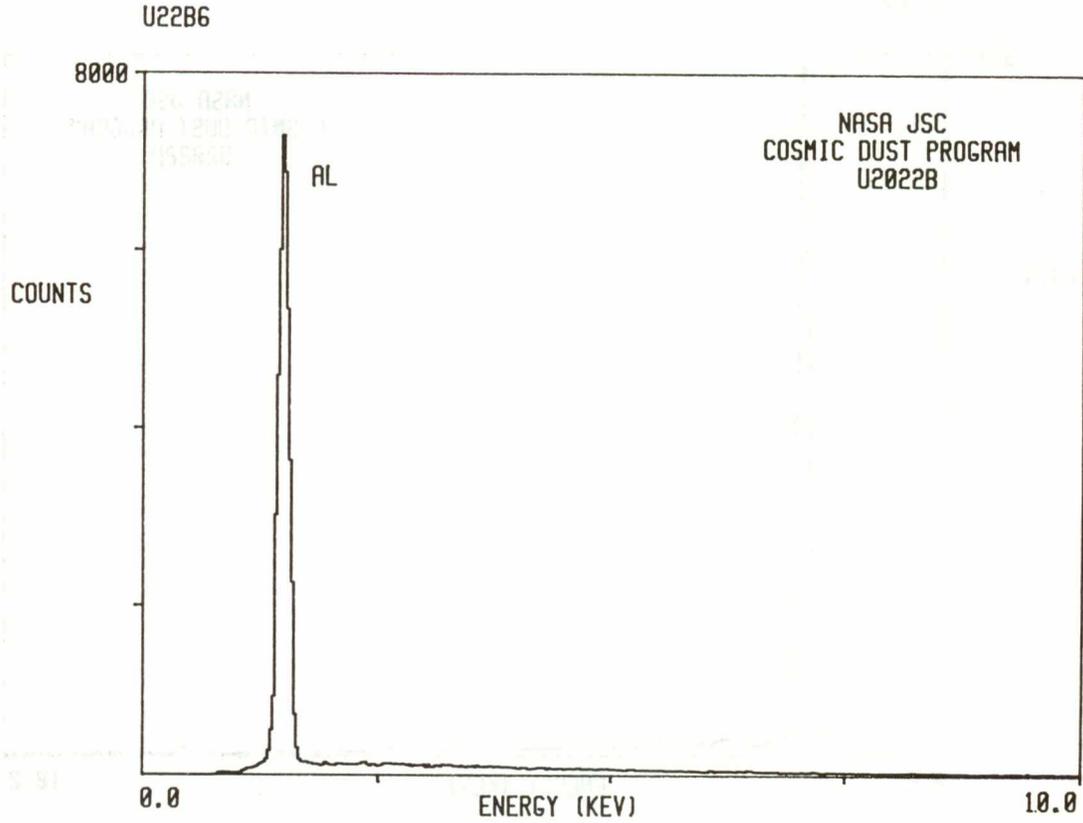
U2022 B 6



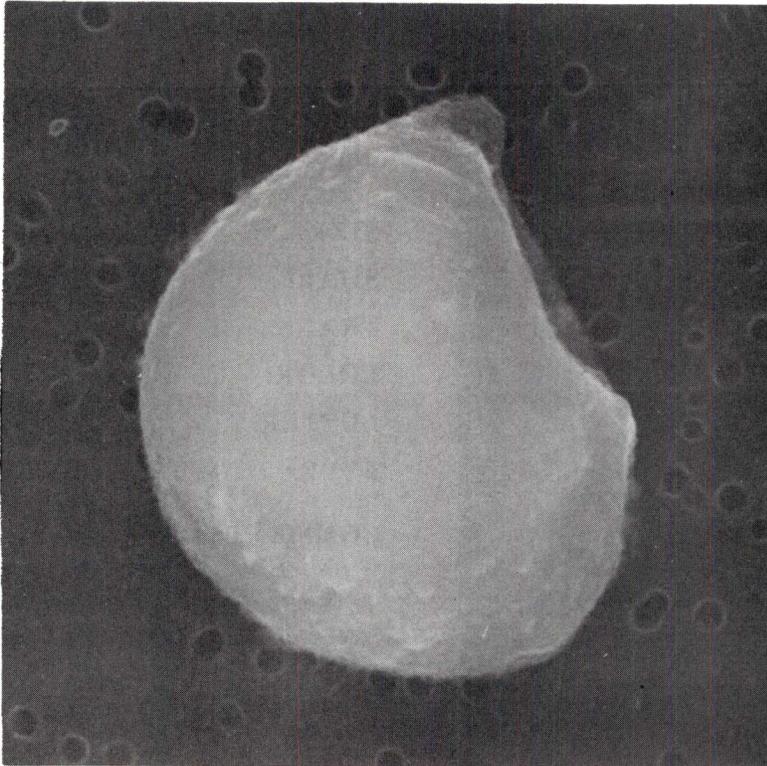
SIZE: 4
SHAPE: S
TRANS.: T
COLOR: Colorless
LUSTER: V
TYPE: AOS

COMMENTS:
May be attached to
U2022B23

S-85-42770

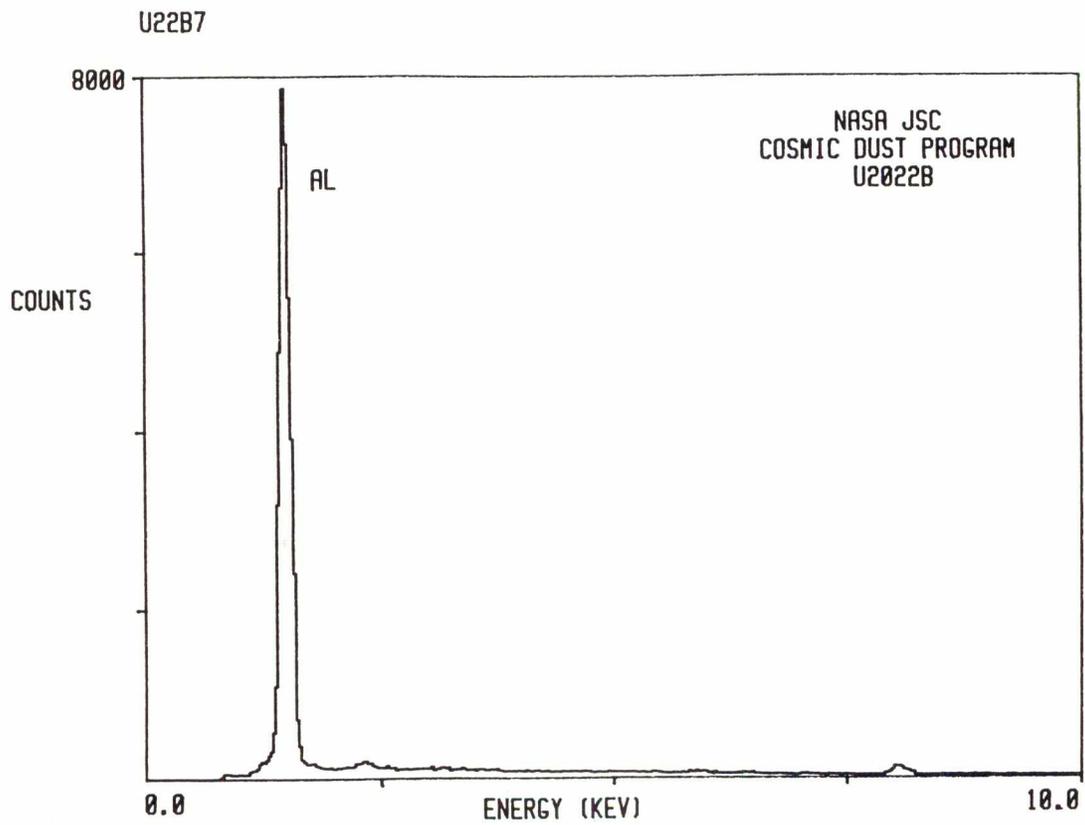


U2022 B 7

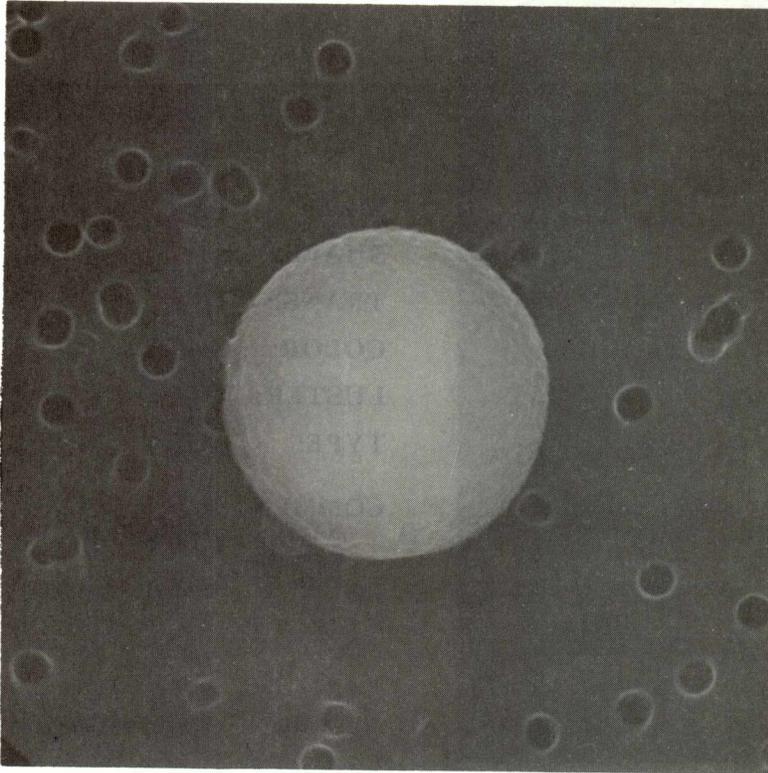


SIZE: 4
SHAPE: I
TRANS.: O
COLOR: Black
LUSTER: D
TYPE: AOS
COMMENTS:

S-85-42771

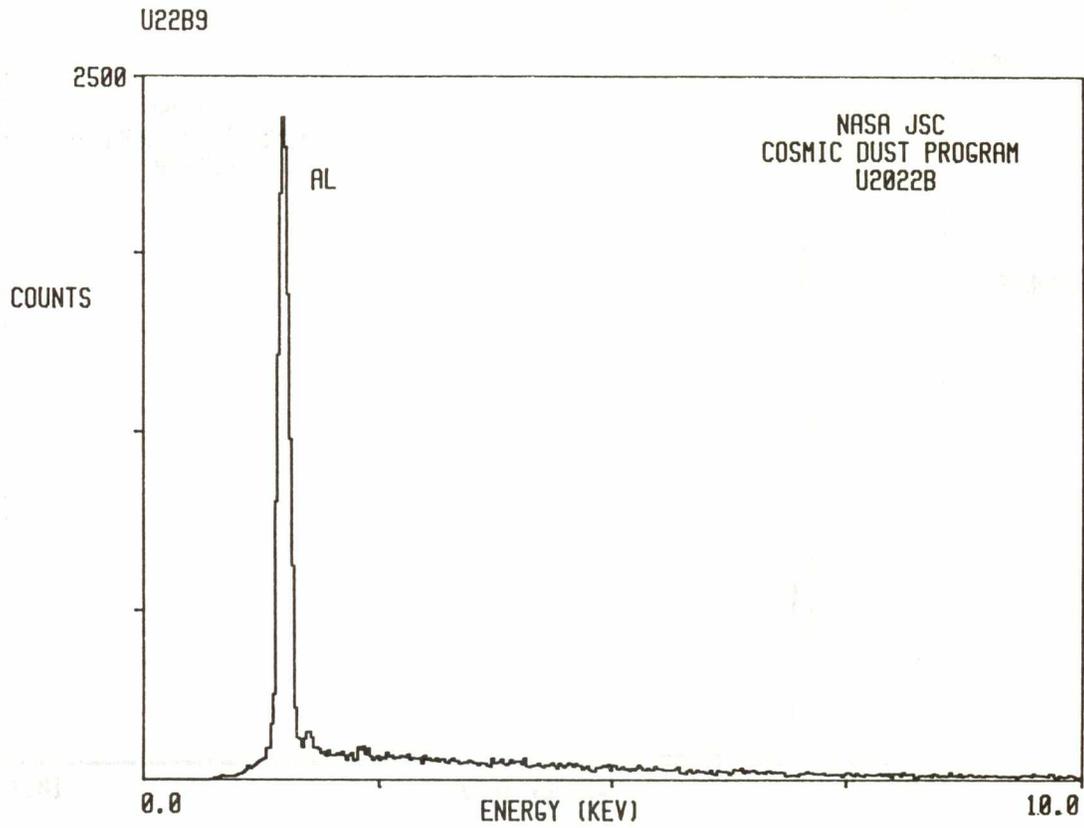


U2022 B 9

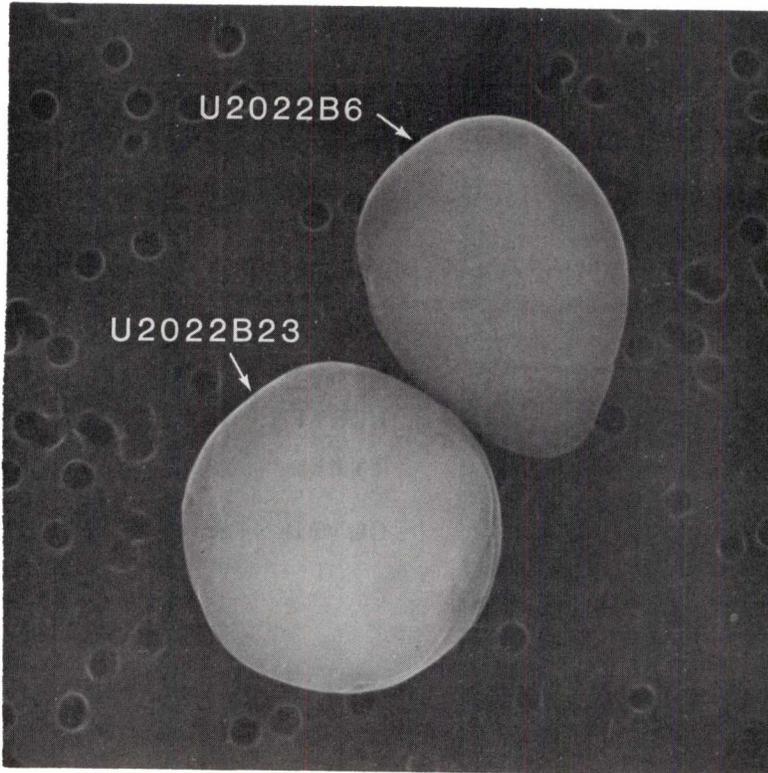


SIZE: 5
SHAPE: S
TRANS.: TL
COLOR: White
LUSTER: V
TYPE: AOS
COMMENTS:

S-85-42773



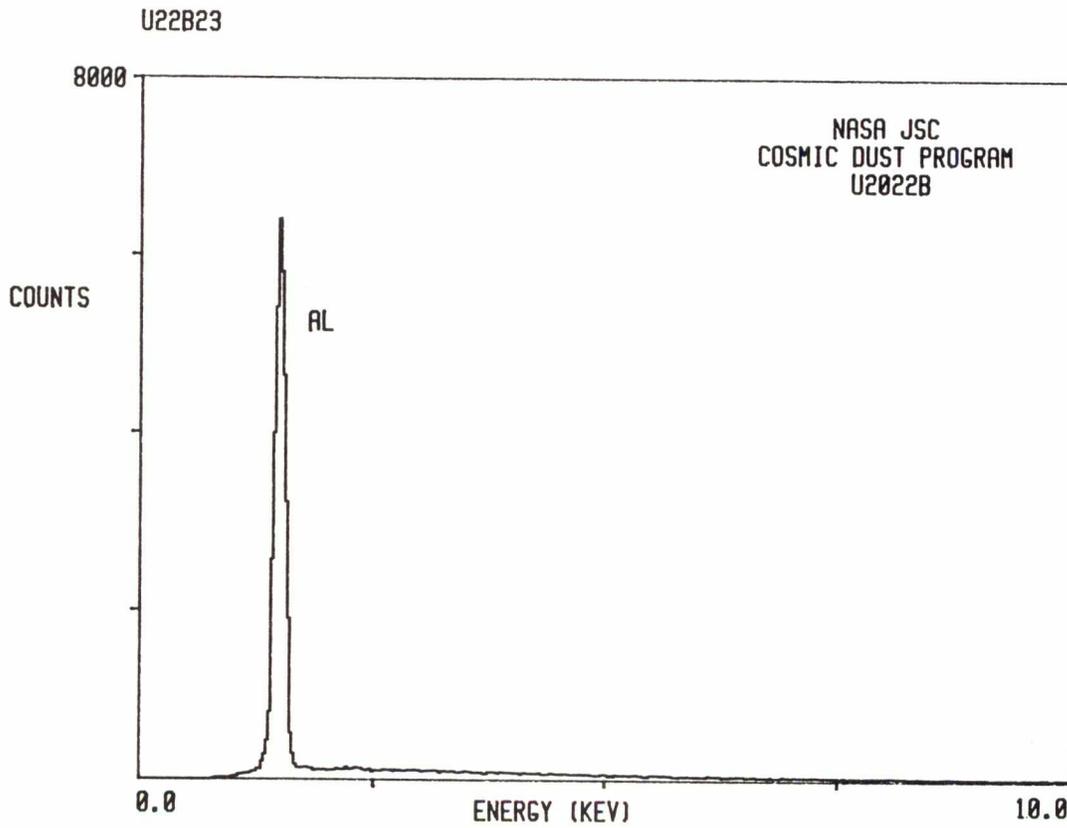
U2022 B 23



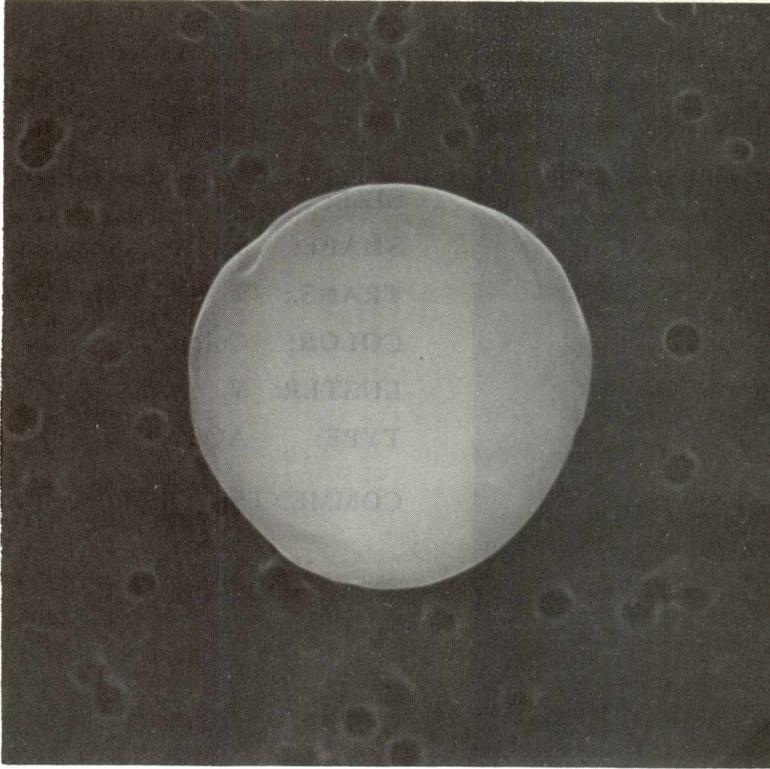
SIZE: 4
SHAPE: S
TRANS.: T
COLOR: Colorless
LUSTER: V
TYPE: AOS

COMMENTS:
May be attached to
U2022B6

S-85-42782

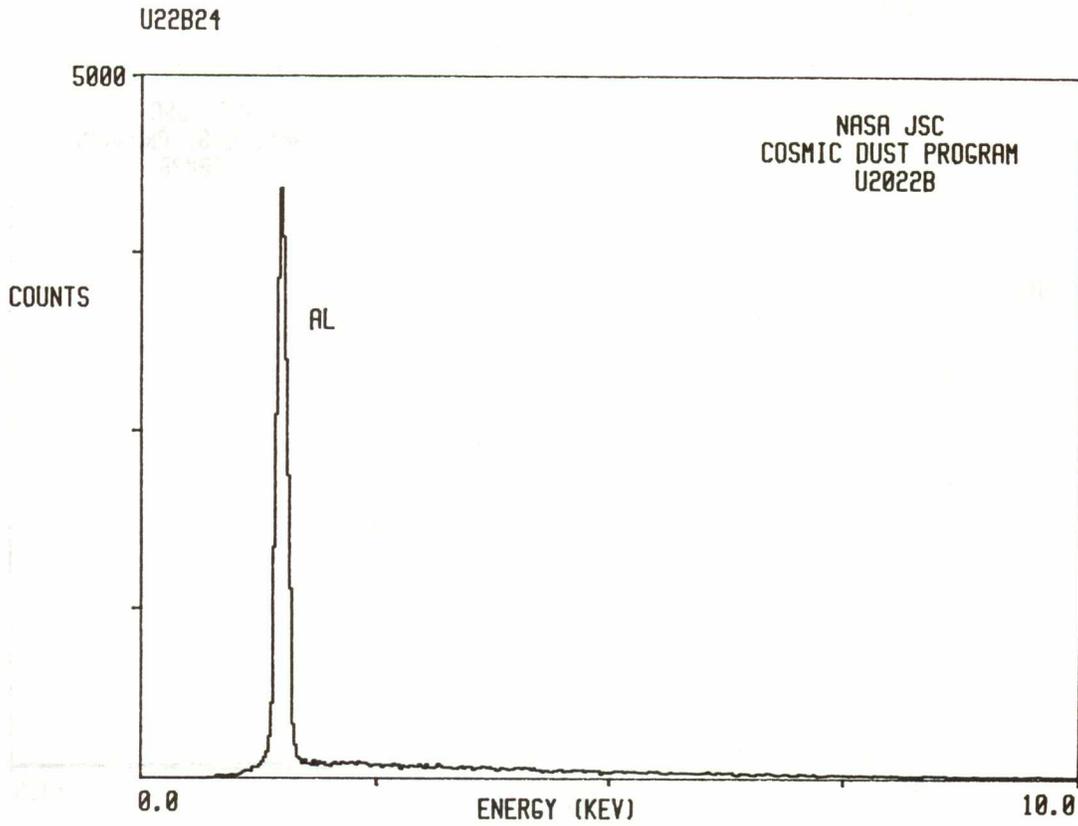


U2022 B 24

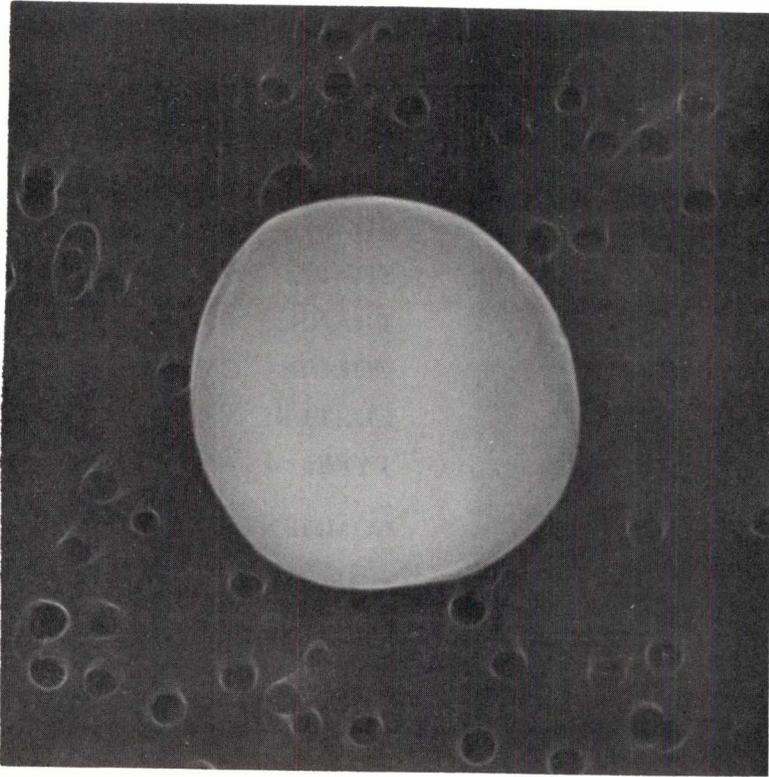


SIZE: 3
SHAPE: S
TRANS.: T
COLOR: Colorless?
LUSTER: V
TYPE: AOS
COMMENTS:

S-85-42783



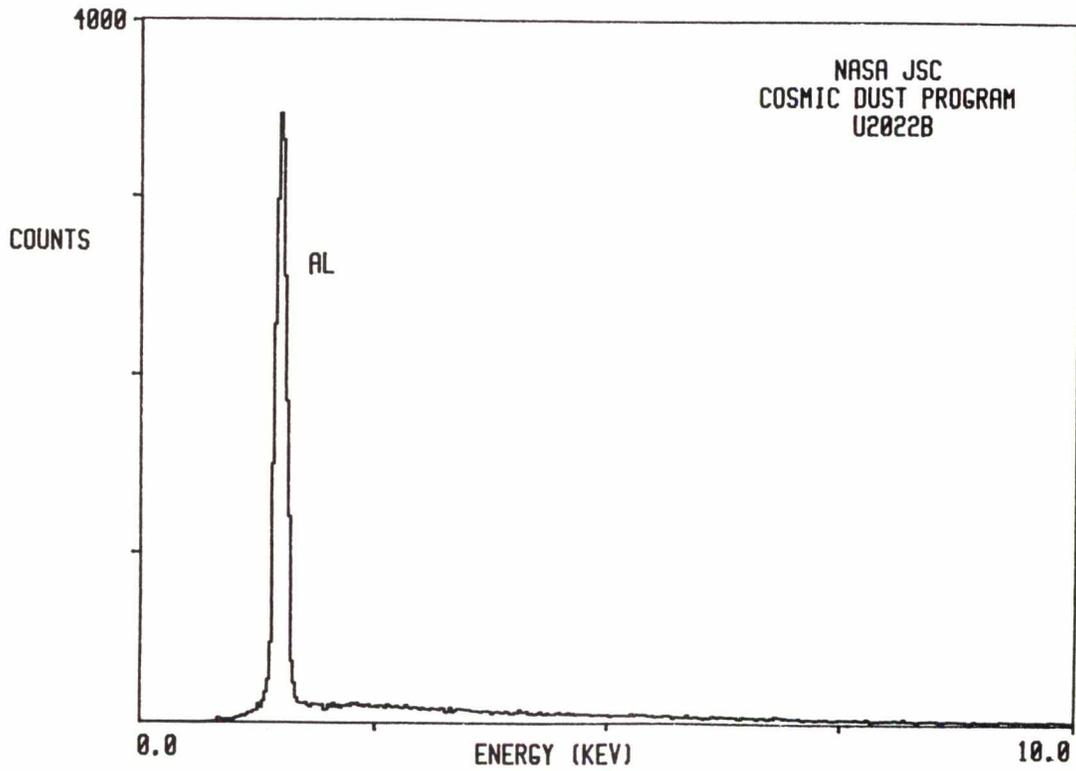
U2022 B 25



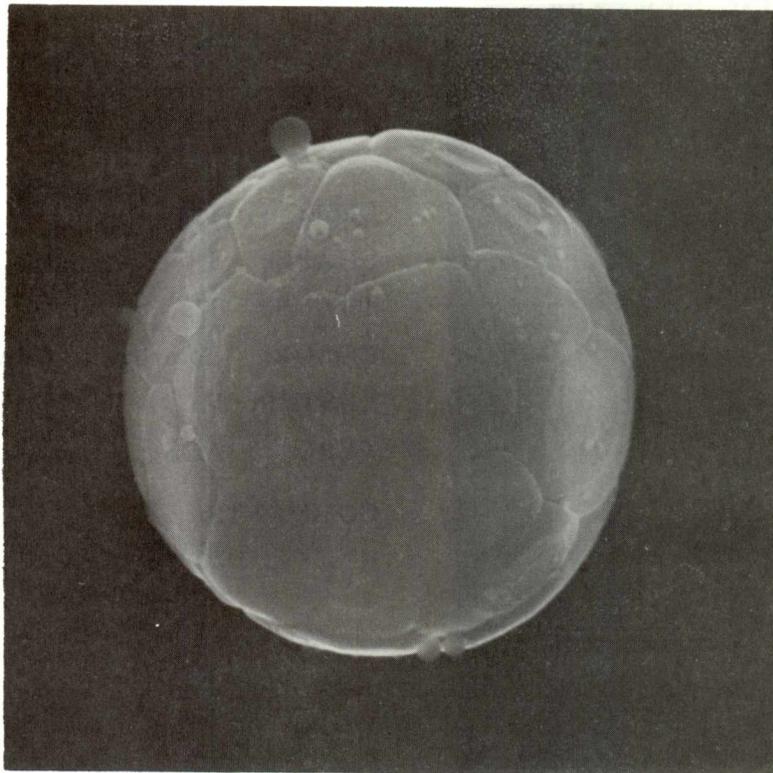
SIZE: 3
SHAPE: S
TRANS.: T
COLOR: Colorless?
LUSTER: V
TYPE: AOS
COMMENTS:

S-85-42784

U22B25

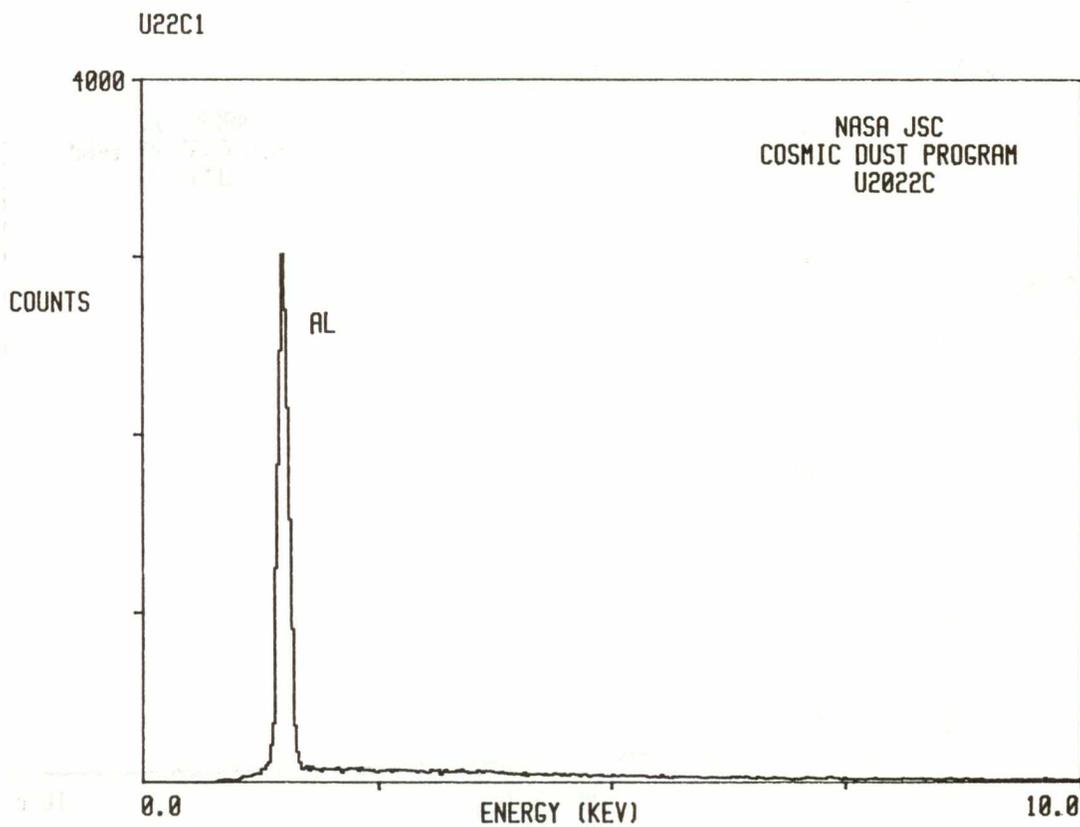


U2022 C 1

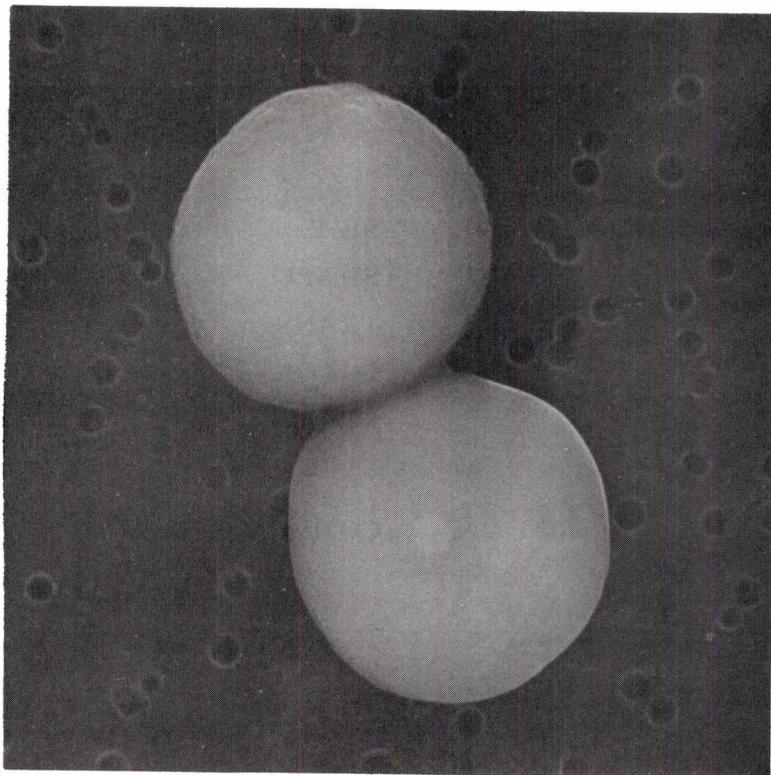


SIZE: 14
SHAPE: S
TRANS.: TC
COLOR: Colorless
LUSTER: V
TYPE: AOS
COMMENTS:

S-85-42785

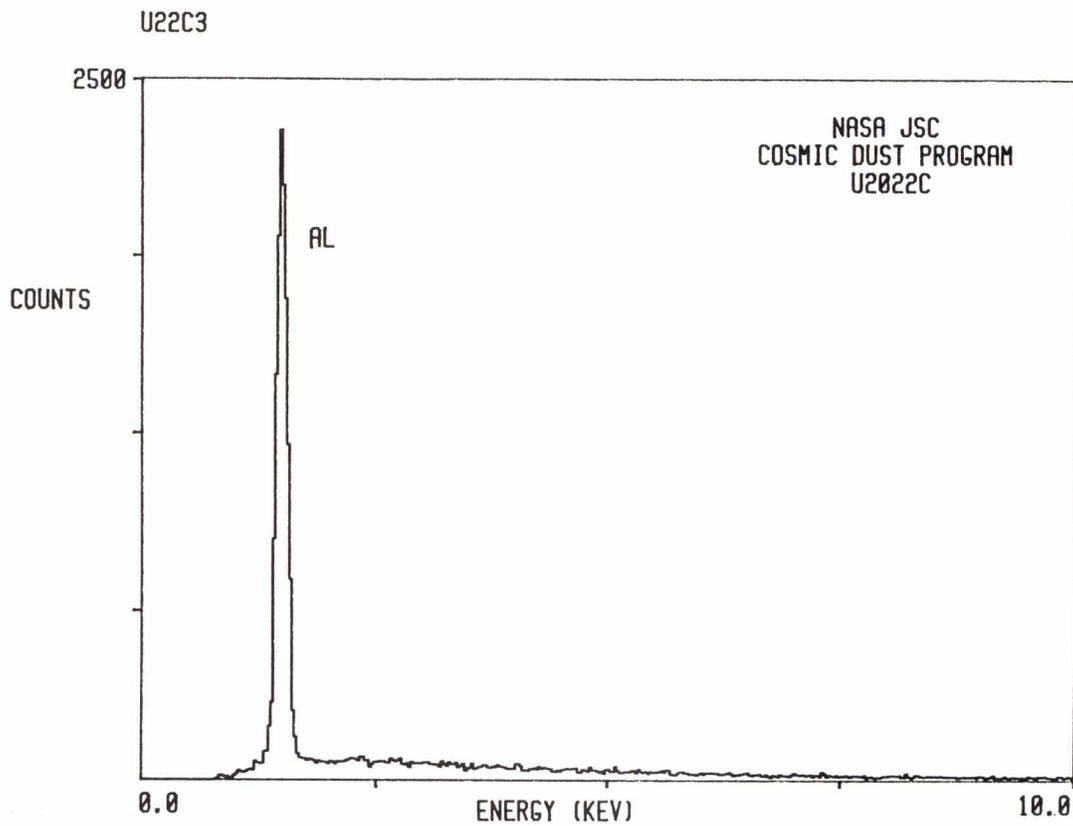


U2022 C 3

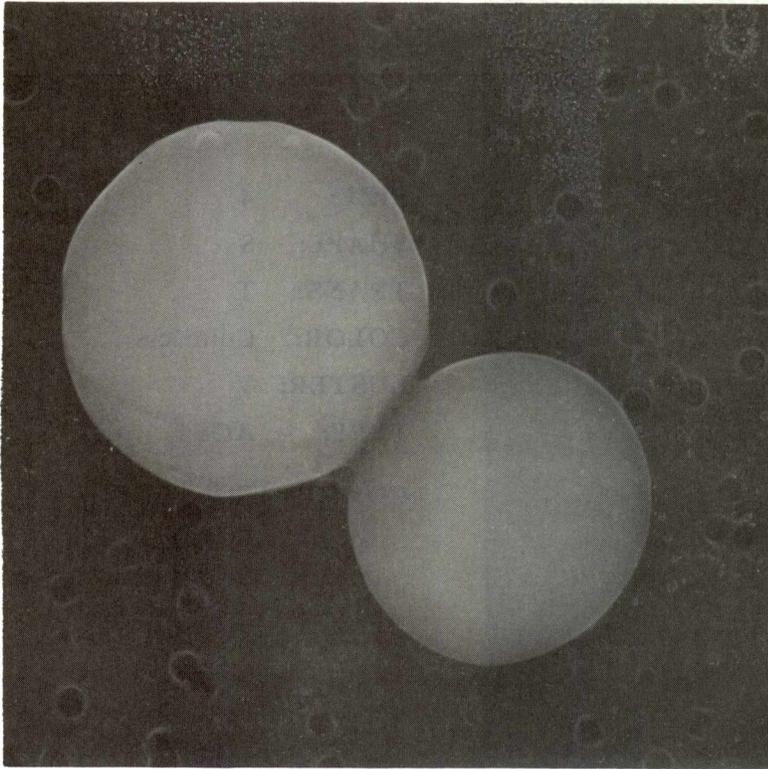


SIZE: 8x4
SHAPE: S
TRANS.: TL
COLOR: Colorless to Brown
LUSTER: V
TYPE: AOS
COMMENTS:
Double sphere

S-85-42786

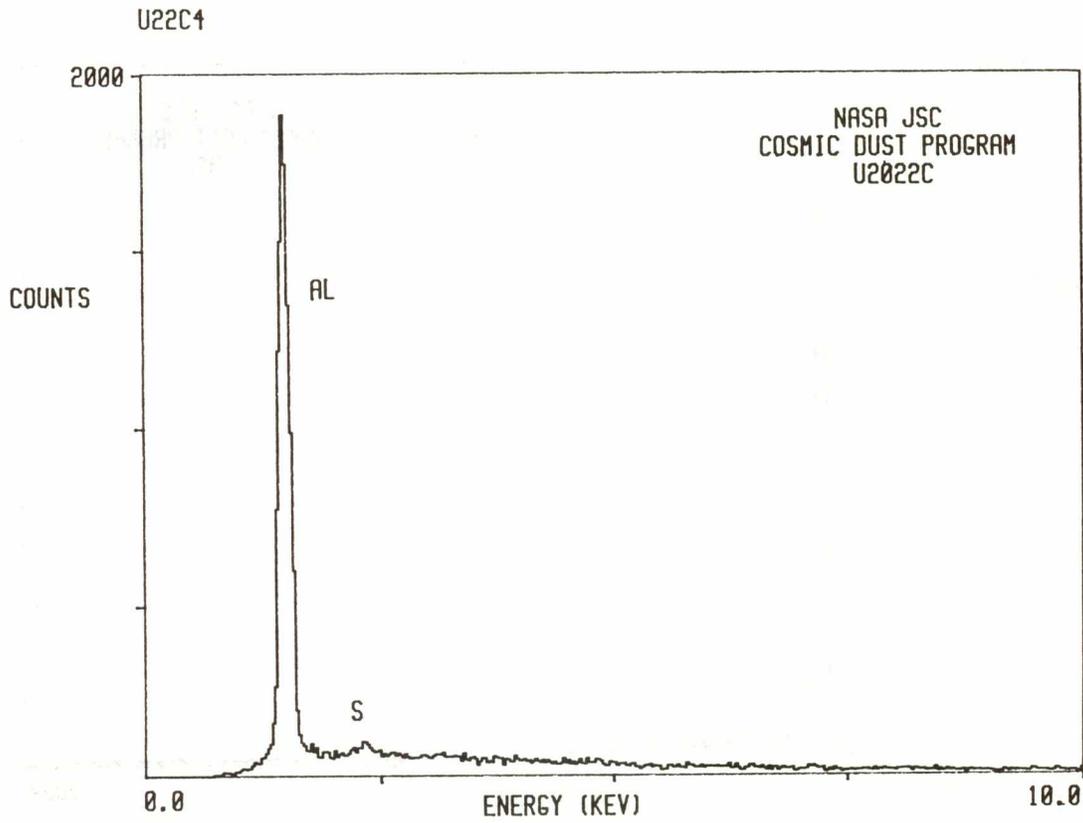


U2022 C 4

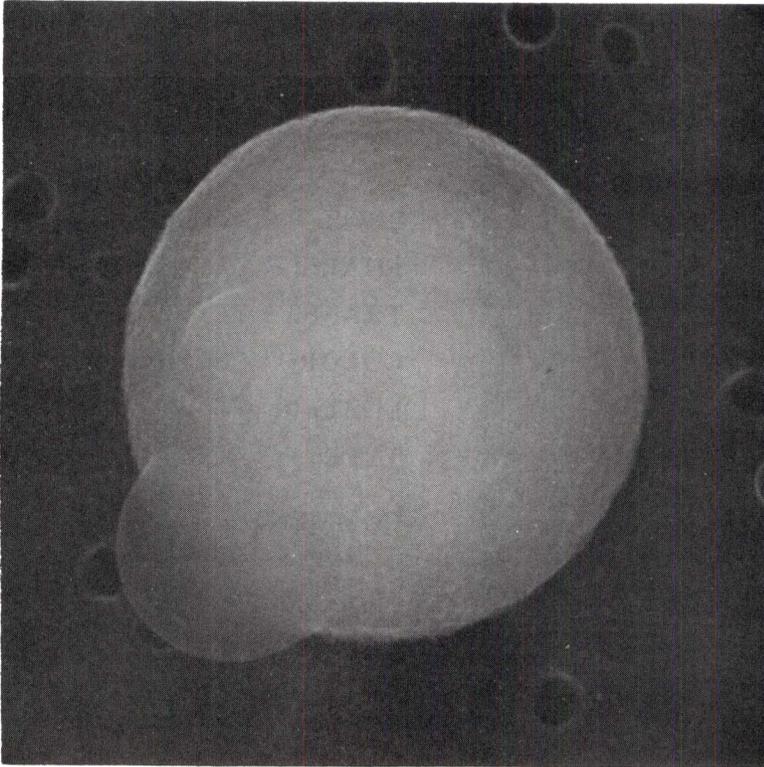


SIZE: 8x4
SHAPE: S
TRANS.: TL
COLOR: Colorless to Brown
LUSTER: V
TYPE: AOS
COMMENTS:
Double sphere

S-85-42787

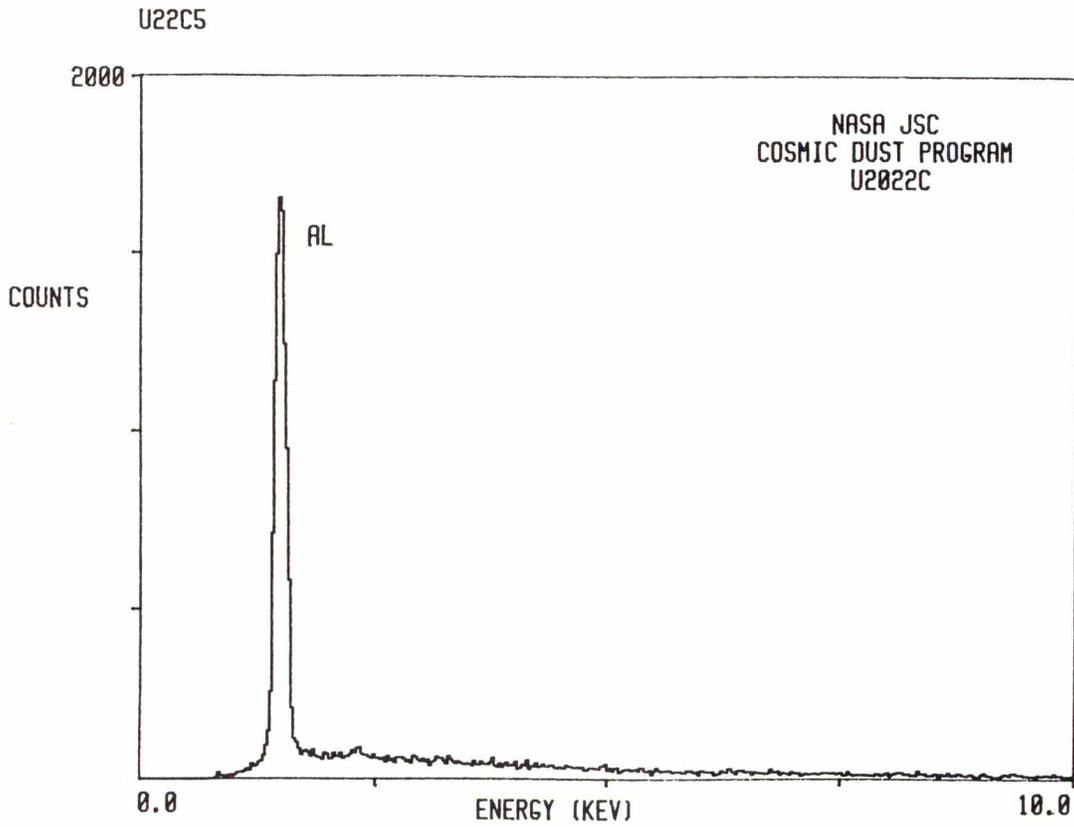


U2022 C 5

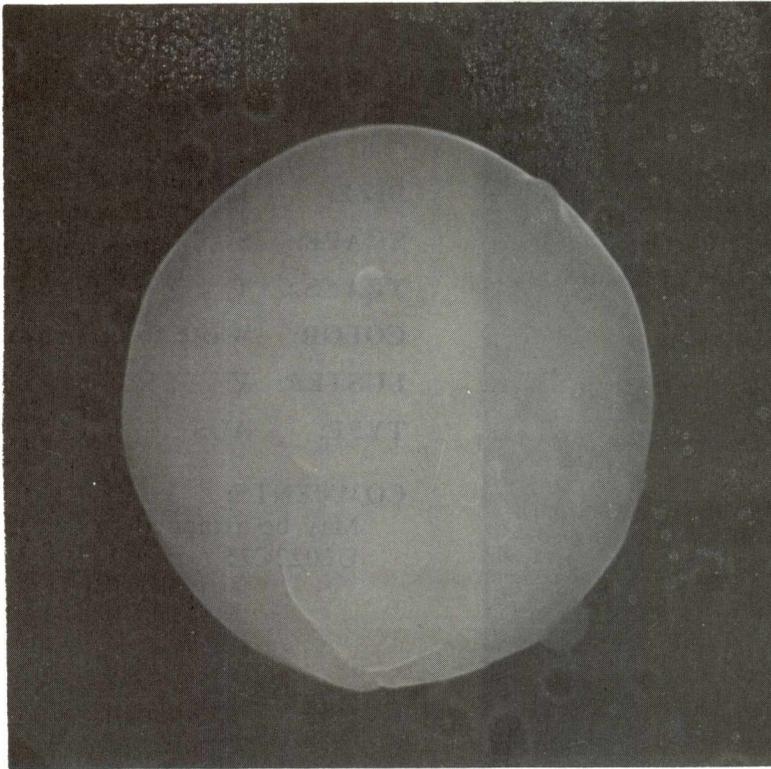


SIZE: 4
SHAPE: S
TRANS.: T
COLOR: Colorless
LUSTER: V
TYPE: AOS
COMMENTS:

S-85-42788

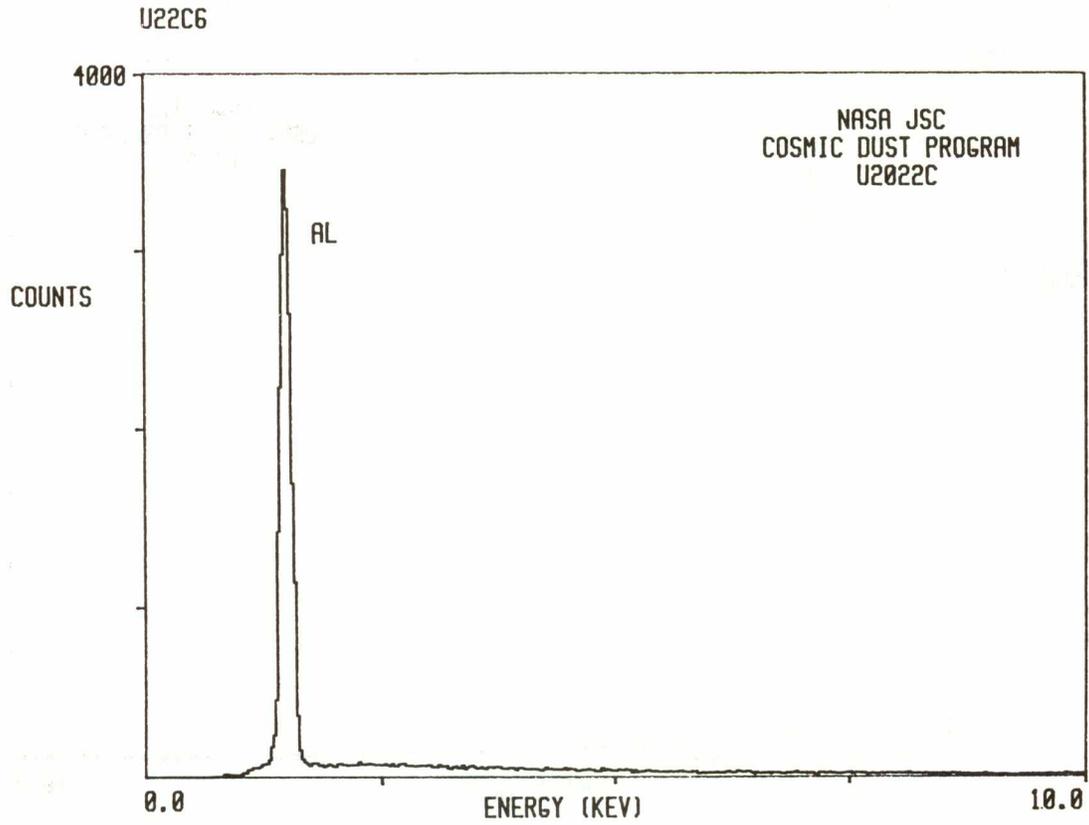


U2022 C 6

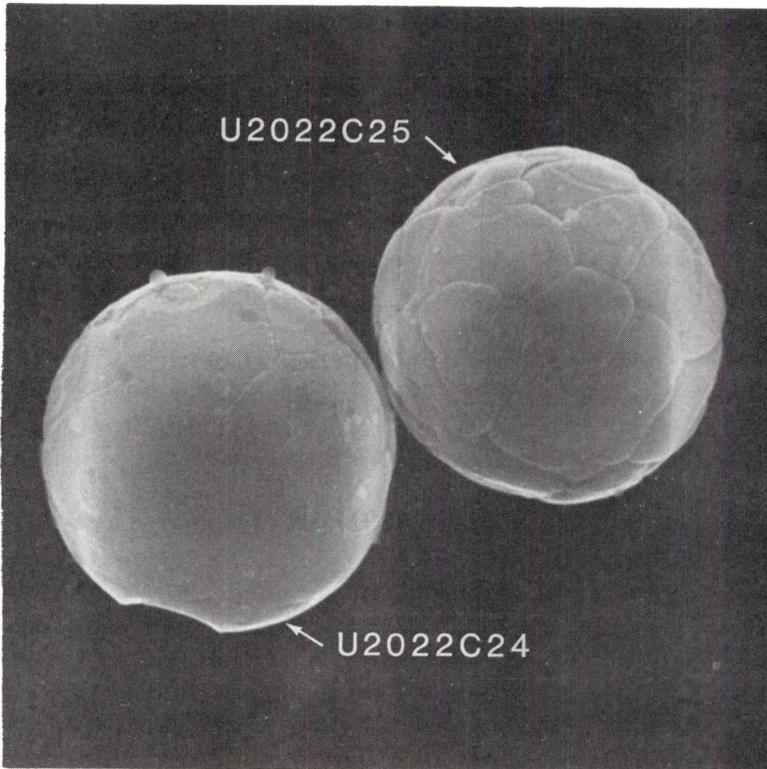


SIZE: 6
SHAPE: S
TRANS.: T
COLOR: Colorless
LUSTER: V
TYPE: AOS
COMMENTS:

S-85-42789



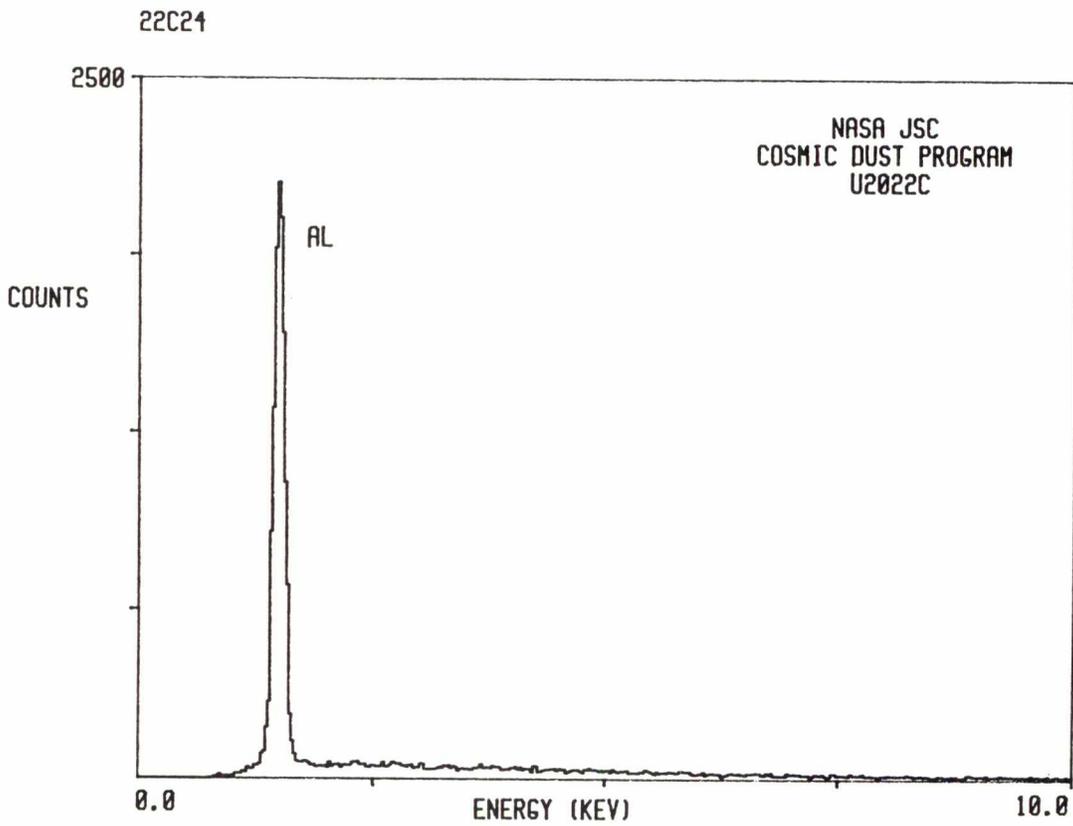
U2022 C 24



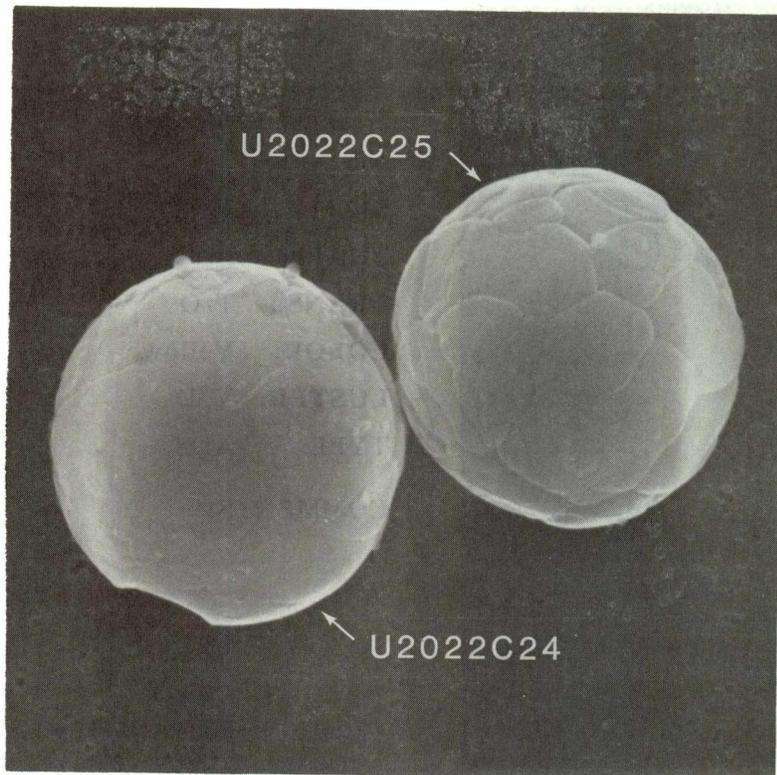
SIZE: 10
SHAPE: S
TRANS.: T
COLOR: White to Colorless
LUSTER: V
TYPE: AOS

COMMENTS:
May be attached to
U2022C25

S-85-42806

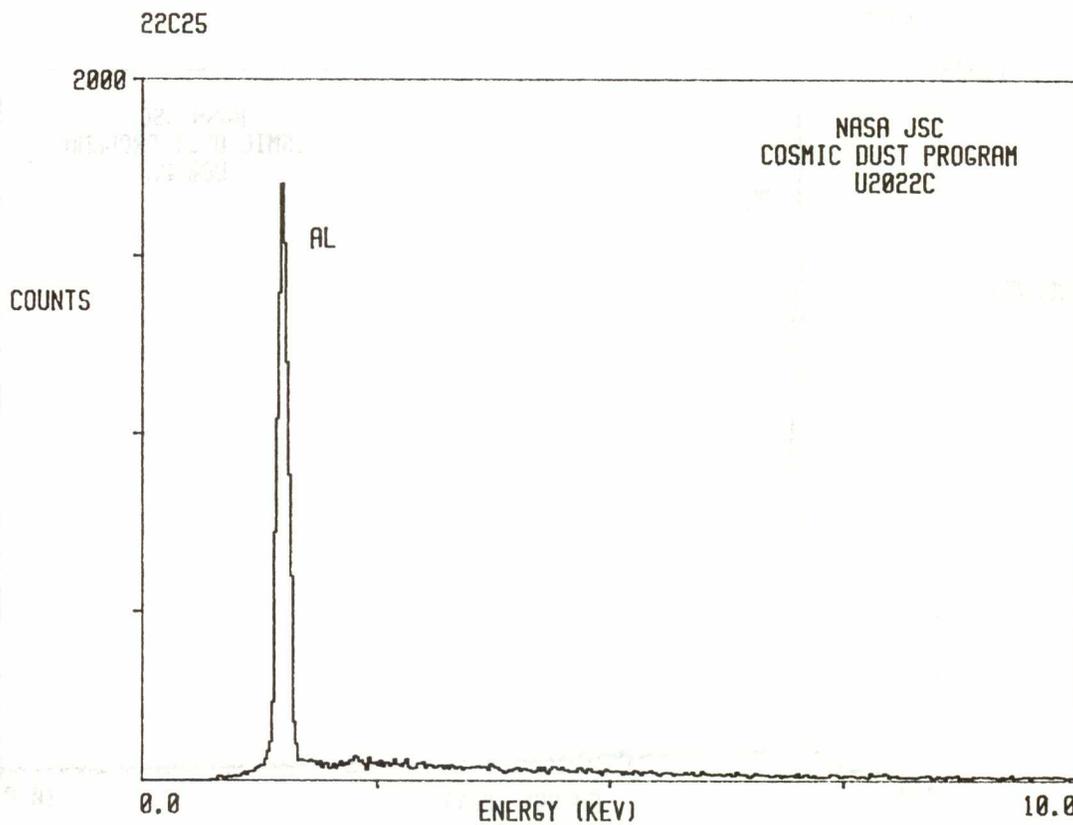


U2022 C 25

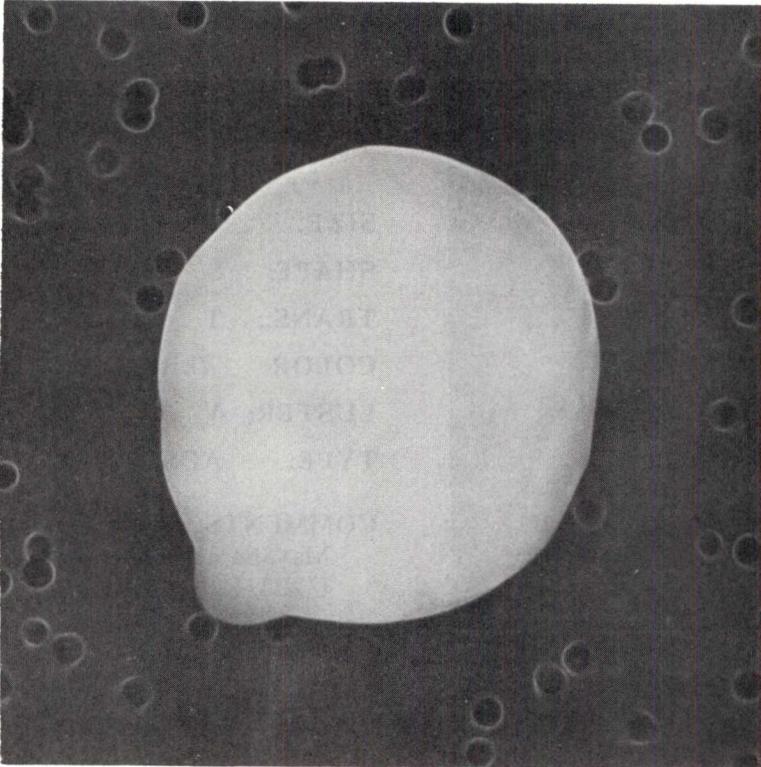


SIZE: 12
SHAPE: S
TRANS.: T
COLOR: White to Colorless
LUSTER: V
TYPE: AOS
COMMENTS:
May be attached to
U2022C24

S-85-42807

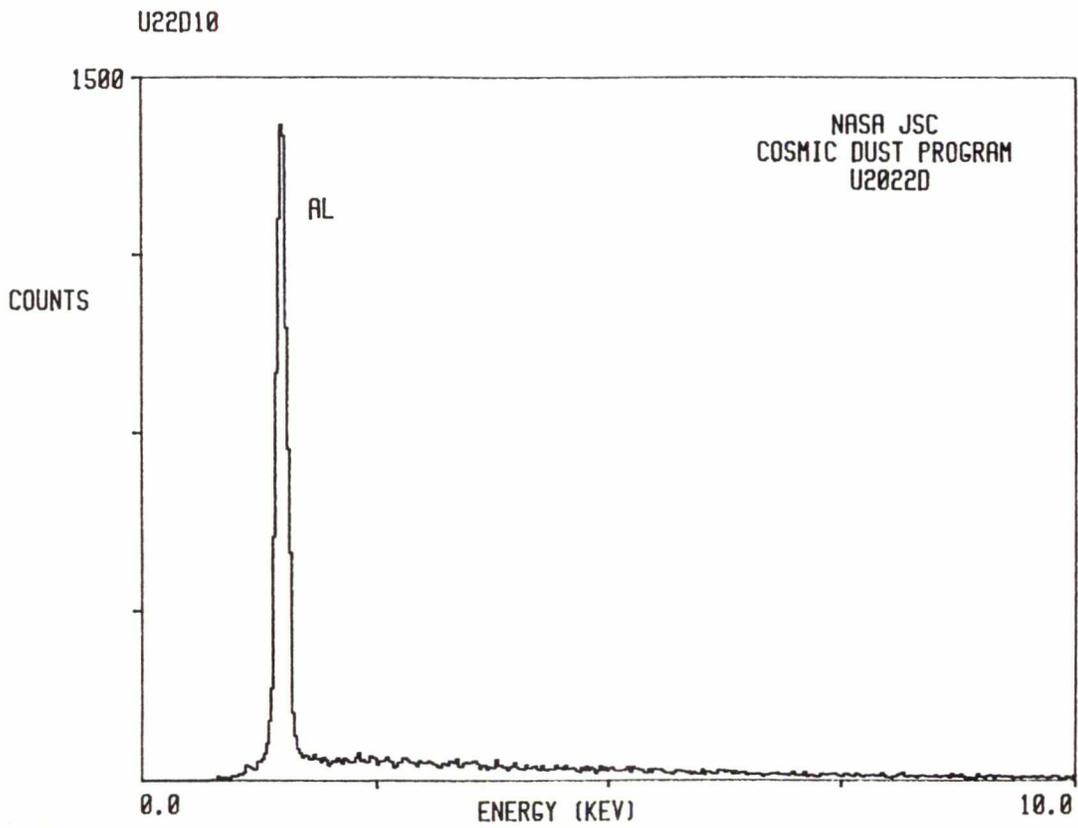


U2022 D 10

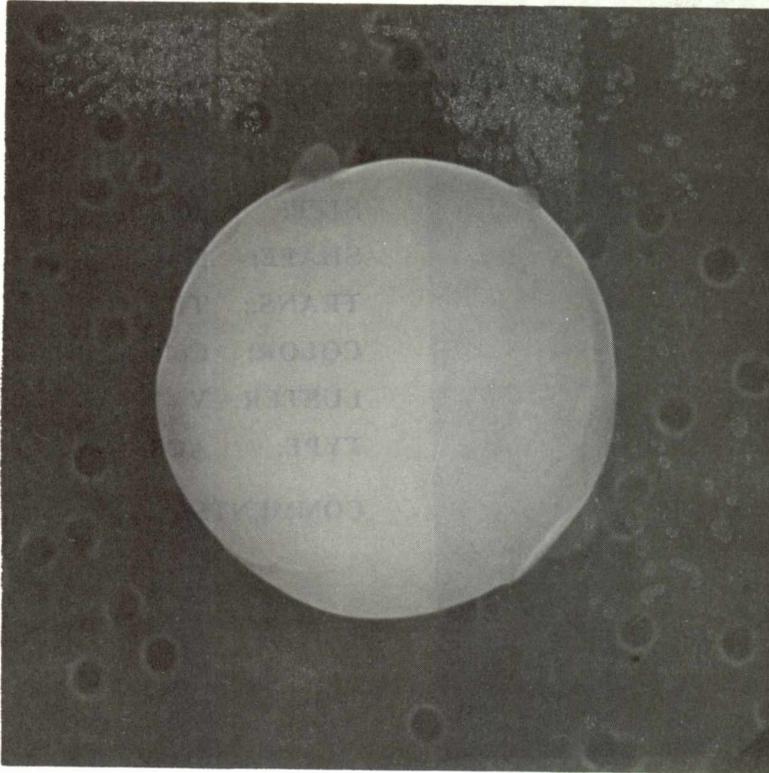


SIZE: 39x30
SHAPE: I
TRANS.: T/O
COLOR: Yellow
LUSTER: V/D
TYPE: AOS
COMMENTS:

S-85-42808



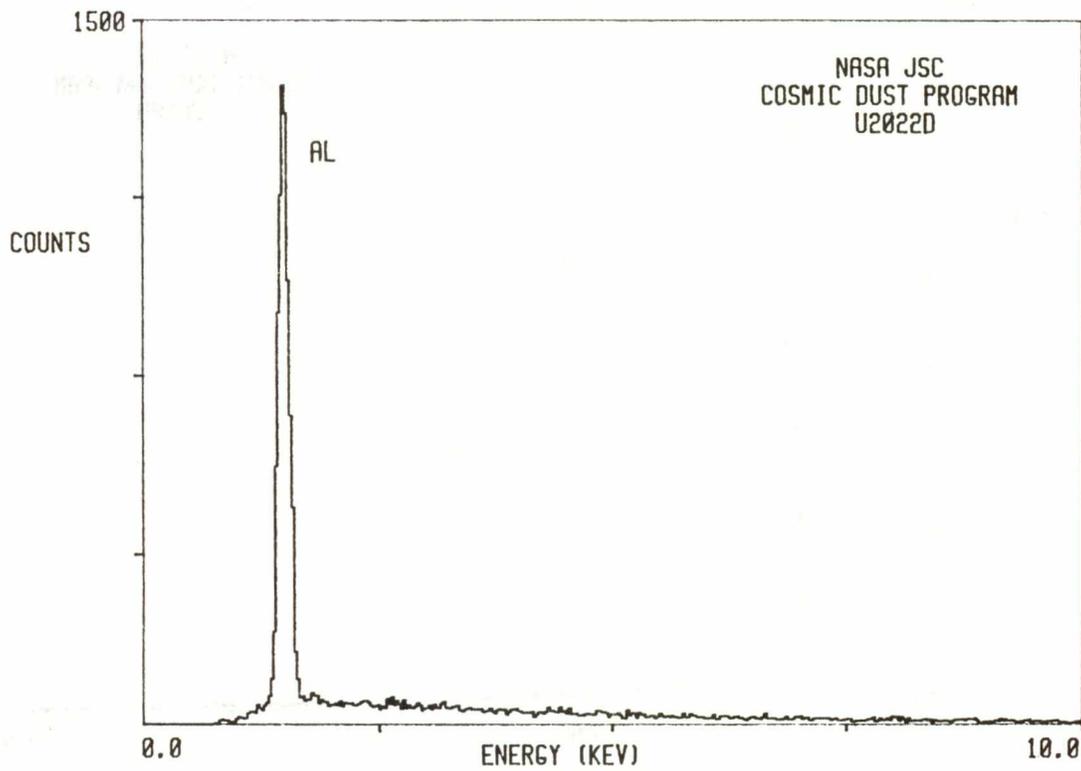
U2022 D 18



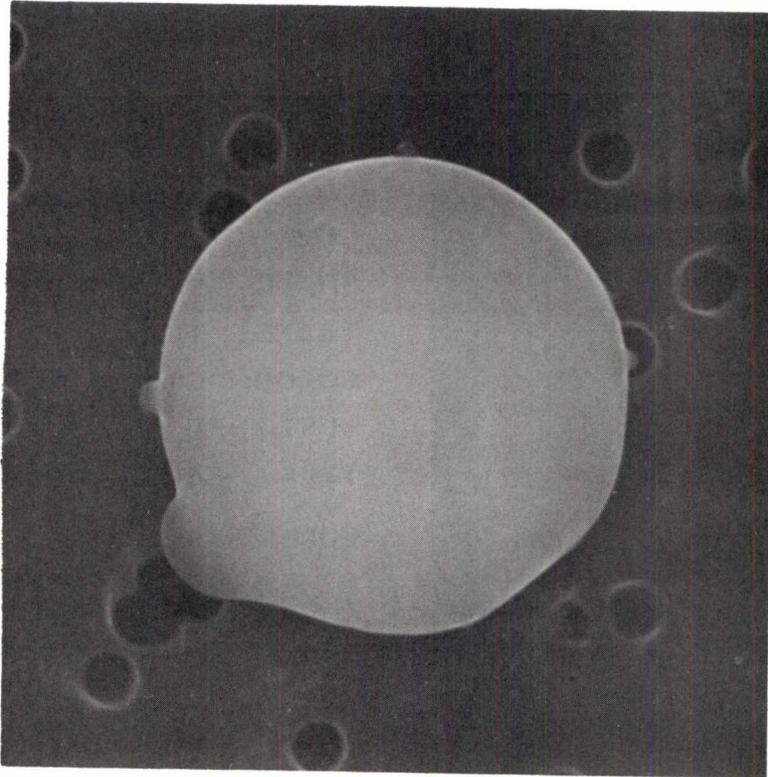
SIZE: 18
SHAPE: S
TRANS.: TL
COLOR: Colorless
LUSTER: V
TYPE: AOS
COMMENTS:

S-85-42821

U22018



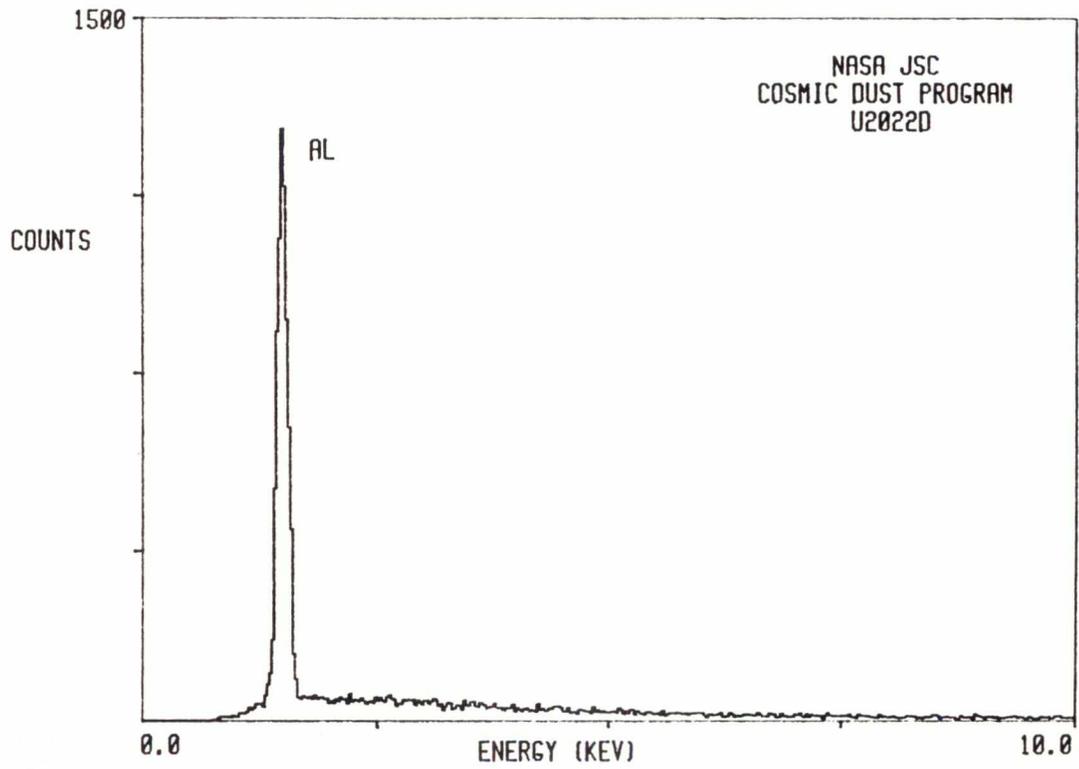
U2022 D 19



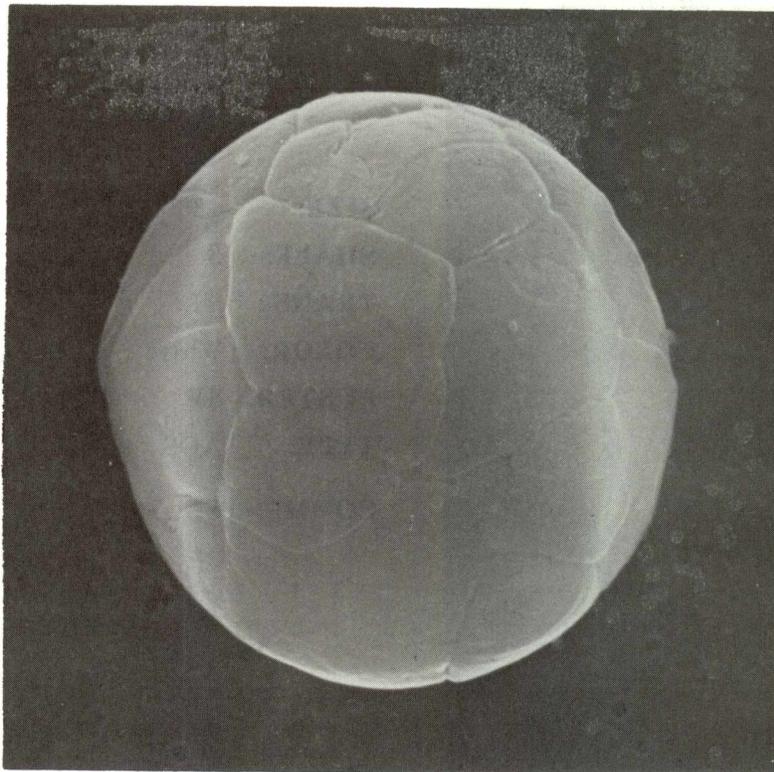
SIZE: 10
SHAPE: S
TRANS.: TL
COLOR: Colorless
LUSTER: V
TYPE: AOS
COMMENTS:

S-85-42814

U22D19

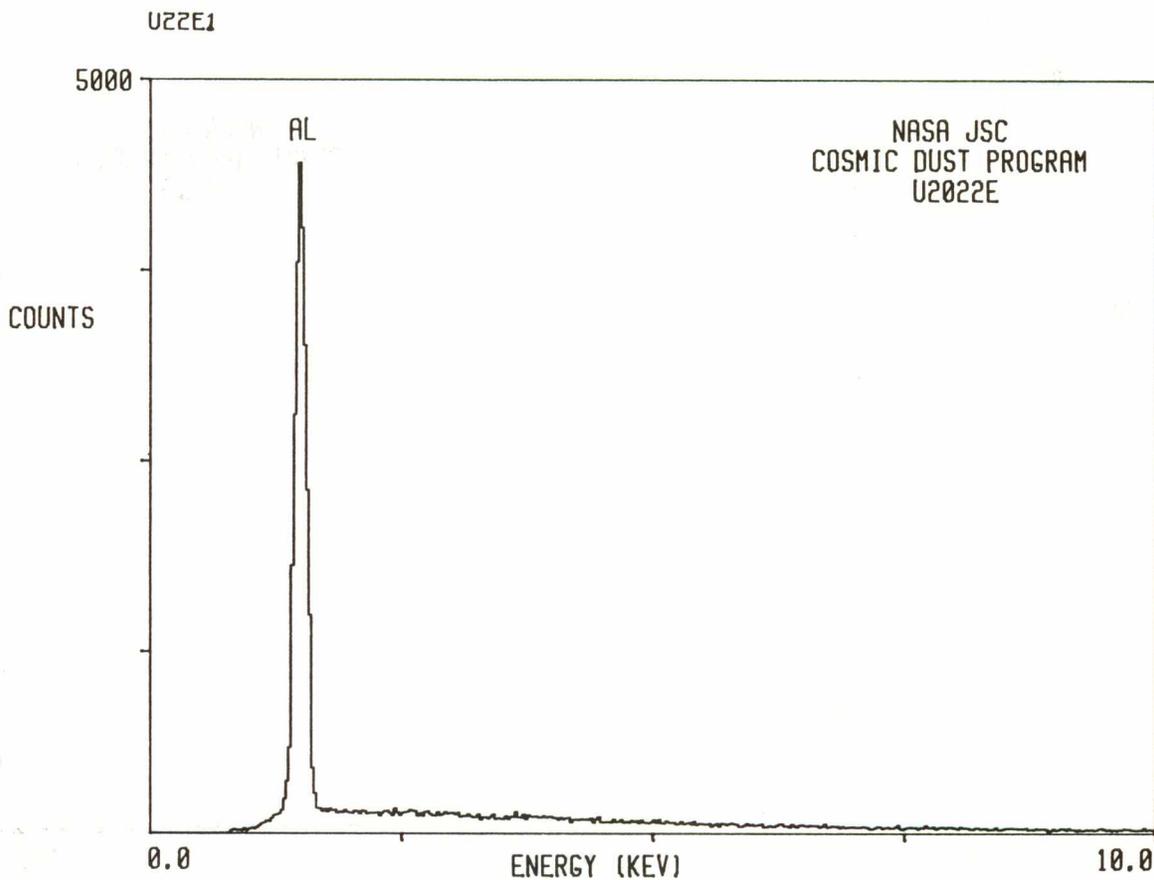


U2022 E 1

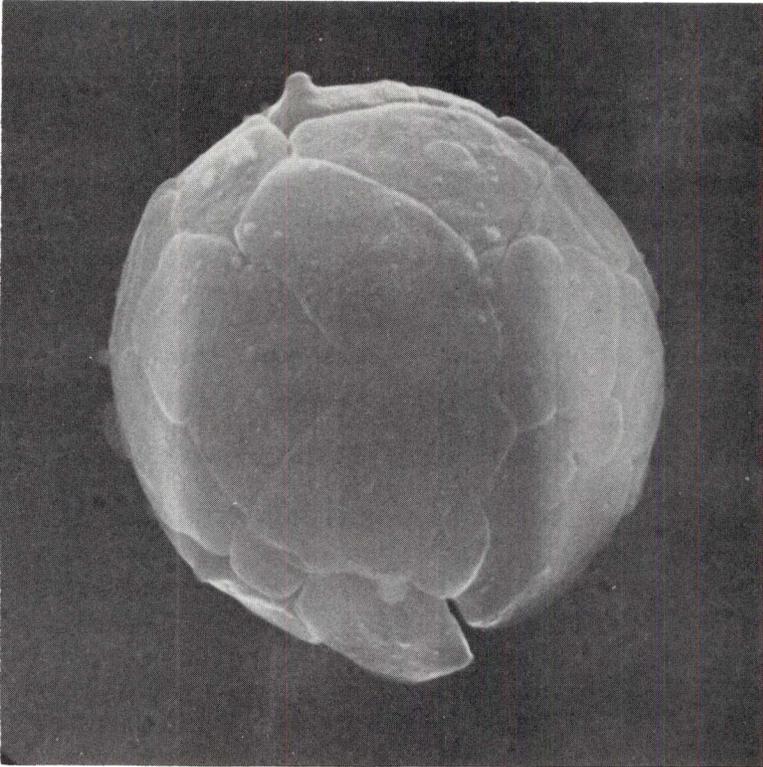


SIZE: 15
SHAPE: S
TRANS.: TL
COLOR: White
LUSTER: SV
TYPE: AOS
COMMENTS:

S-85-42822

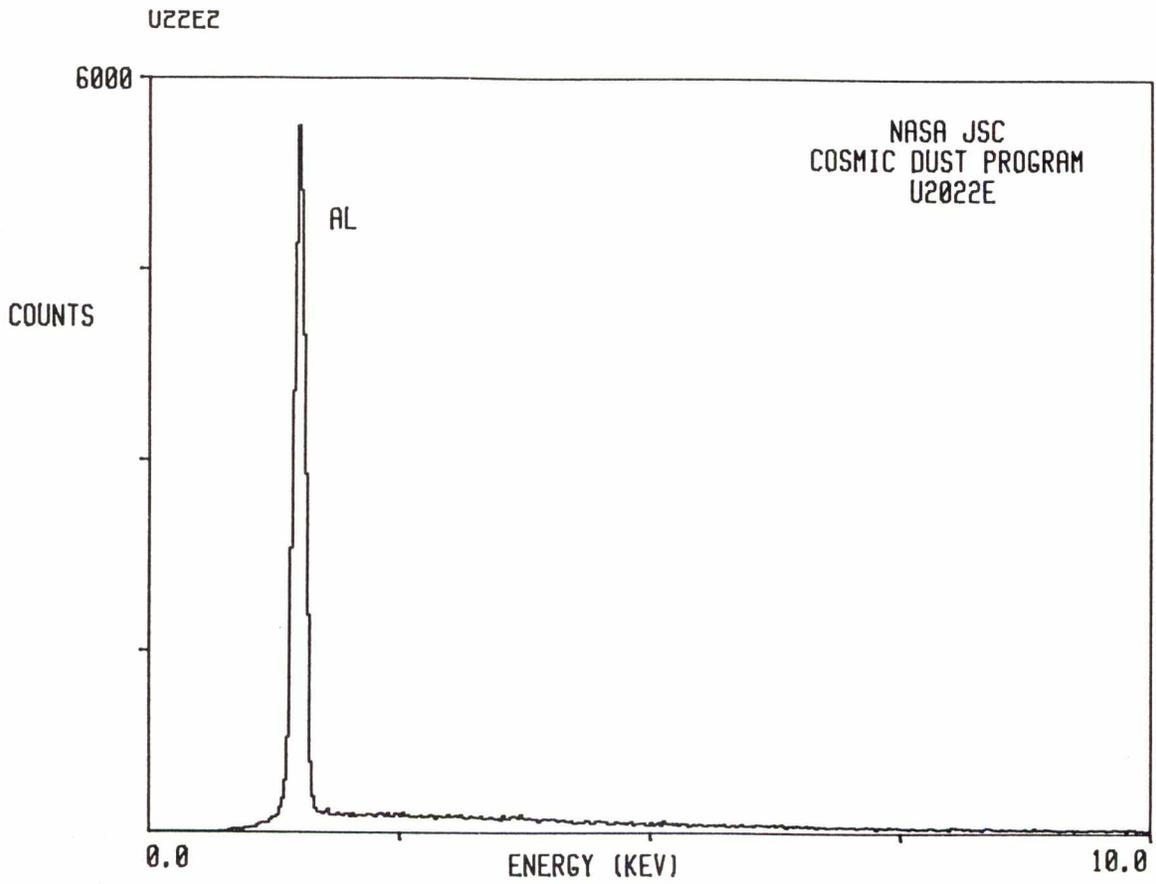


U2022 E 2

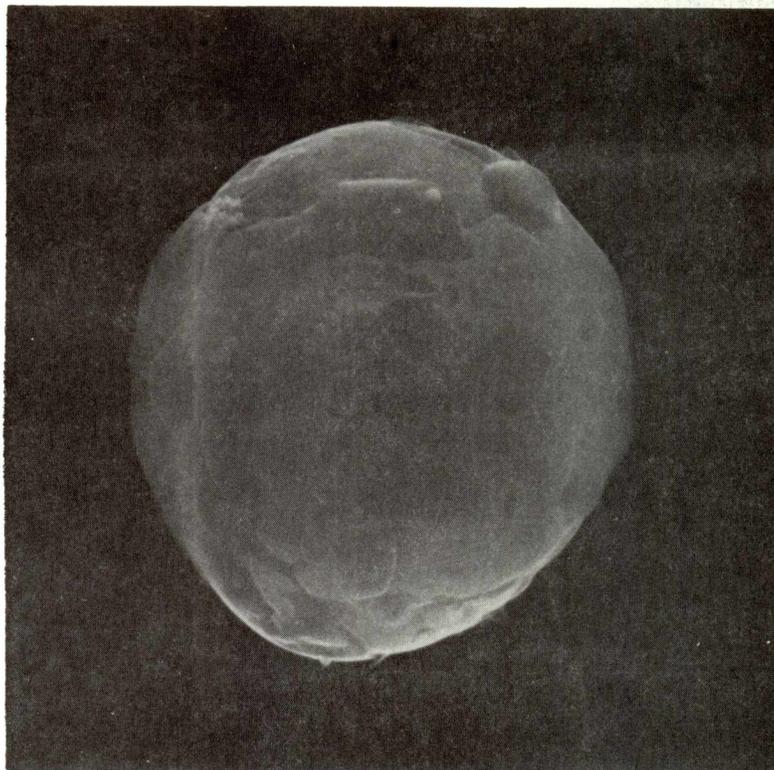


SIZE: 18
SHAPE: S
TRANS.: TL
COLOR: White
LUSTER: SV
TYPE: AOS
COMMENTS:

S-85-42823

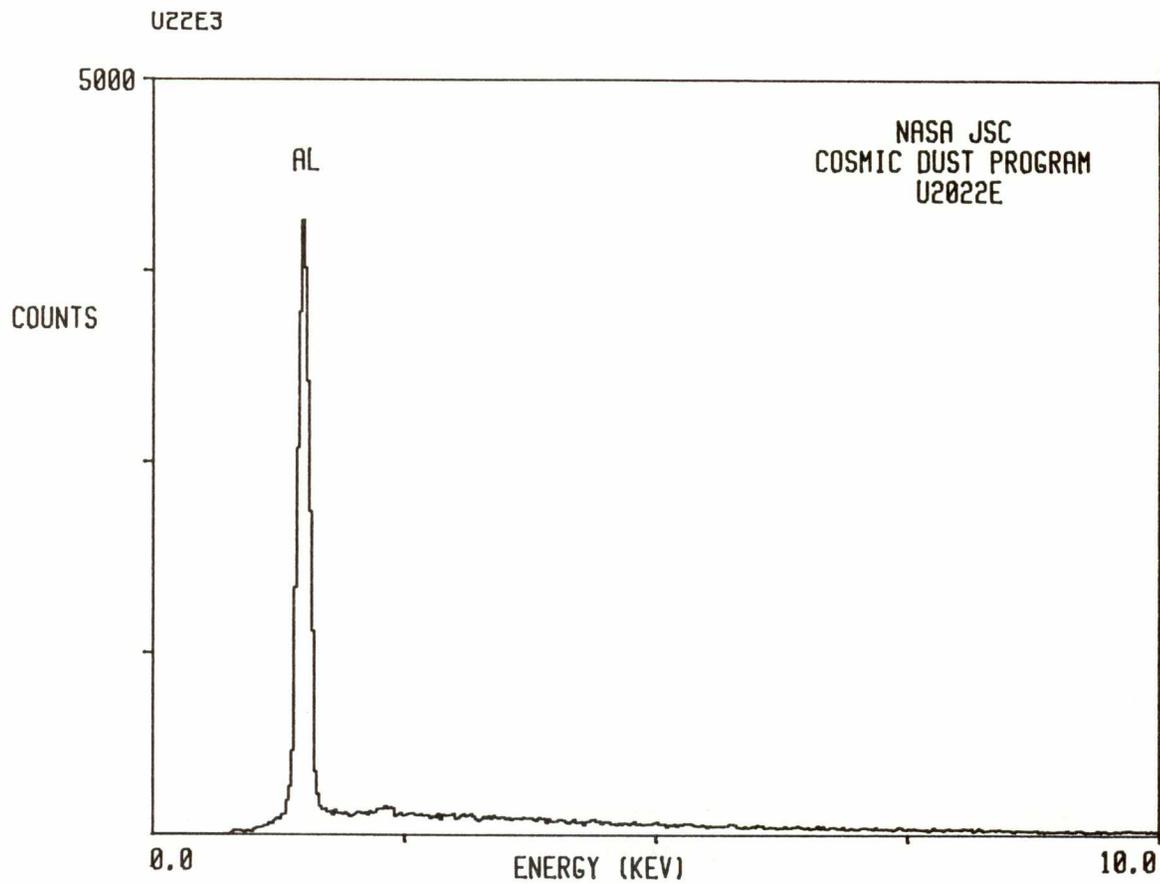


U2022 E 3

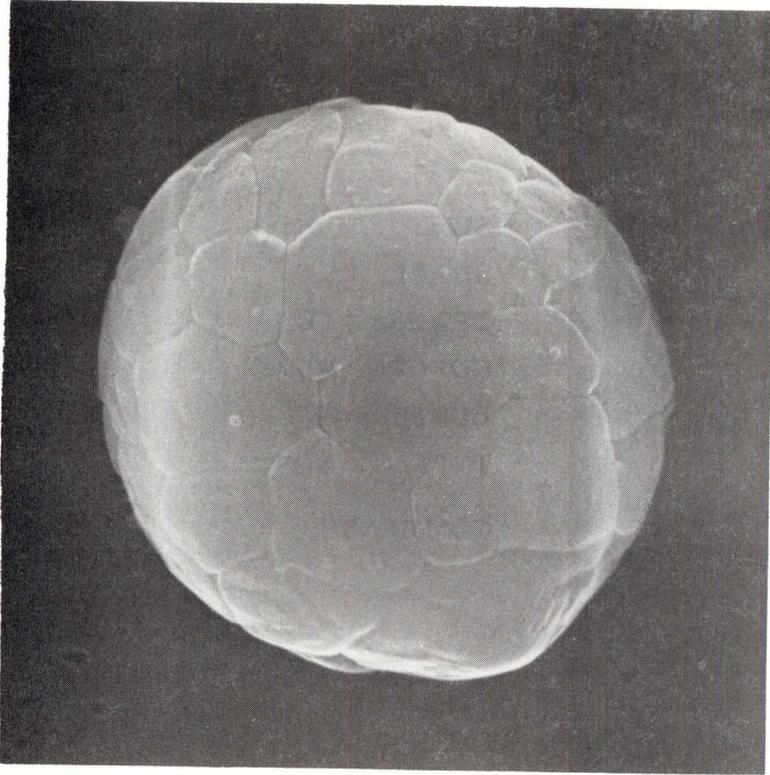


SIZE: 15
SHAPE: S
TRANS.: TL
COLOR: White
LUSTER: SV
TYPE: AOS
COMMENTS:

S-85-42824

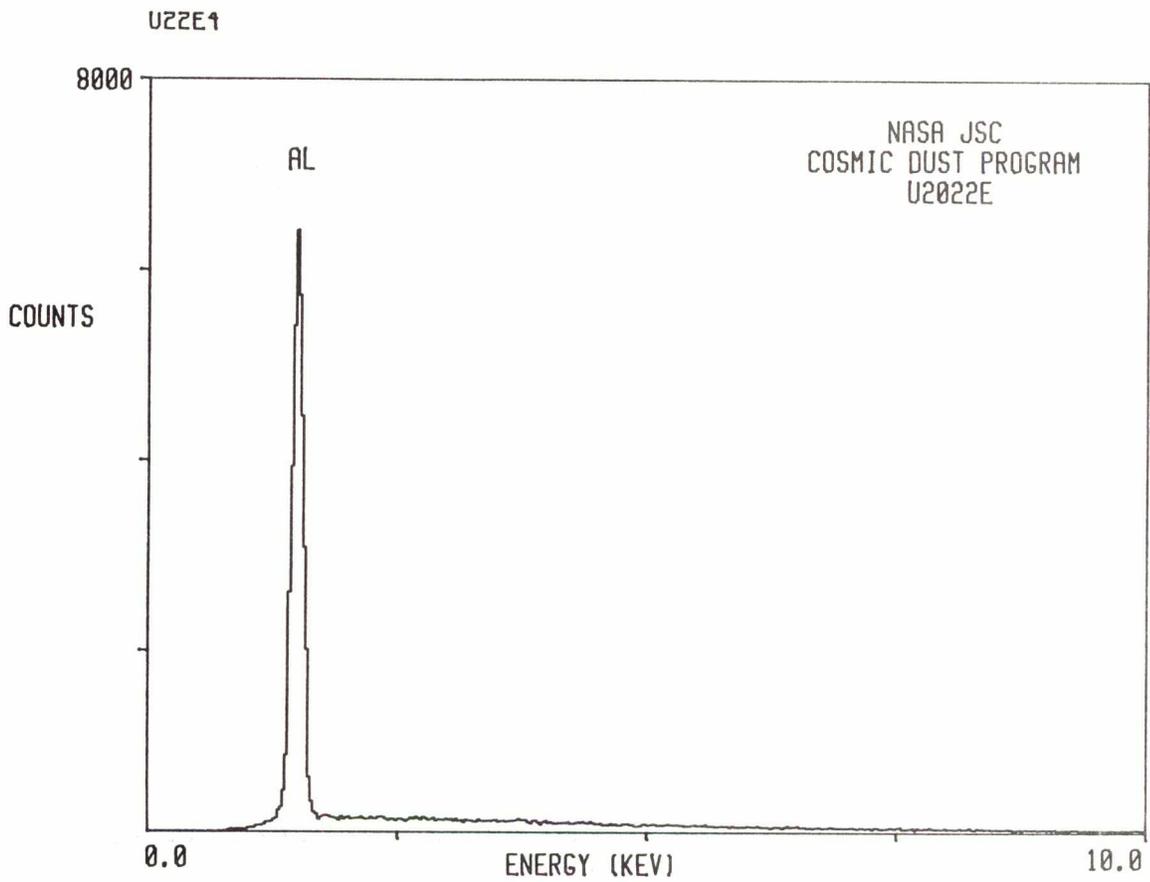


U2022 E 4



SIZE: 18
SHAPE: S
TRANS.: TL
COLOR: White
LUSTER: SV
TYPE: AOS
COMMENTS:

S-85-42825

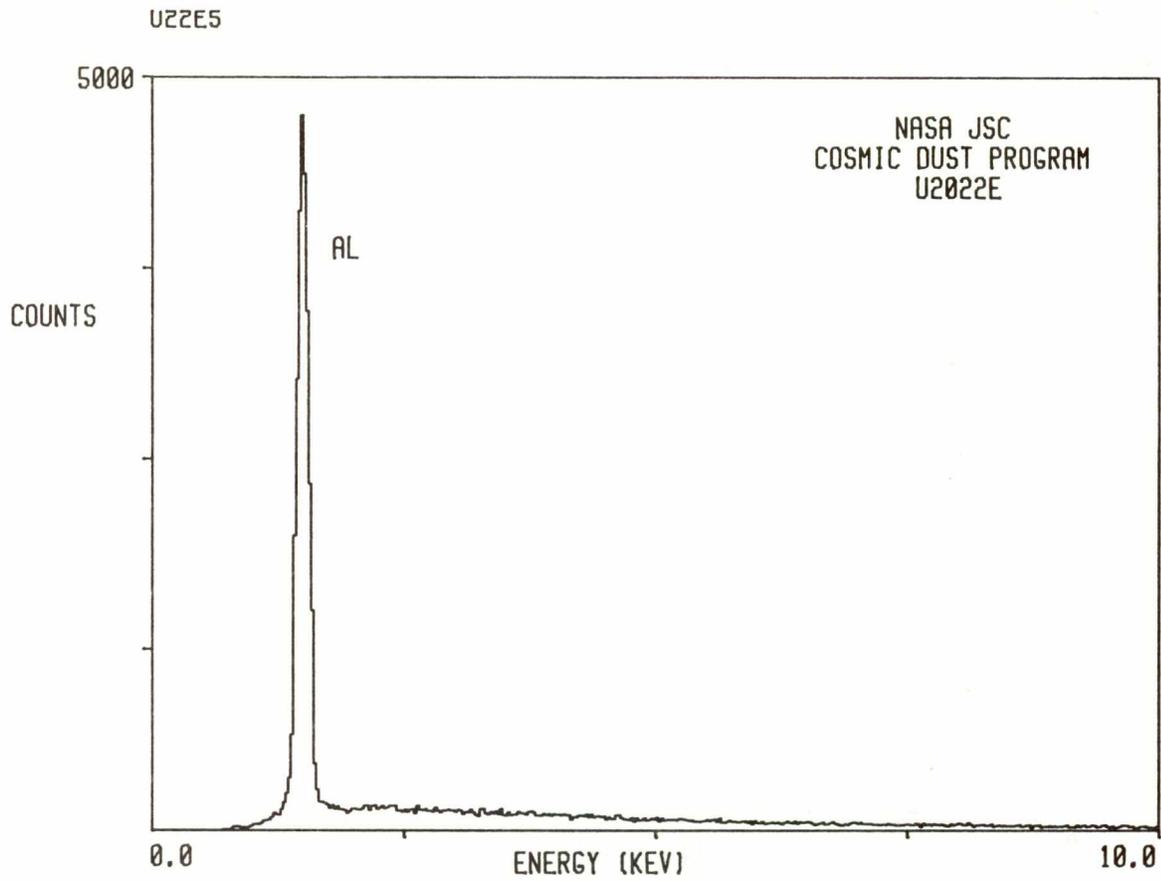


U2022 E 5



SIZE: 10
SHAPE: S
TRANS.: TL
COLOR: White
LUSTER: SV
TYPE: AOS
COMMENTS:

S-85-42826



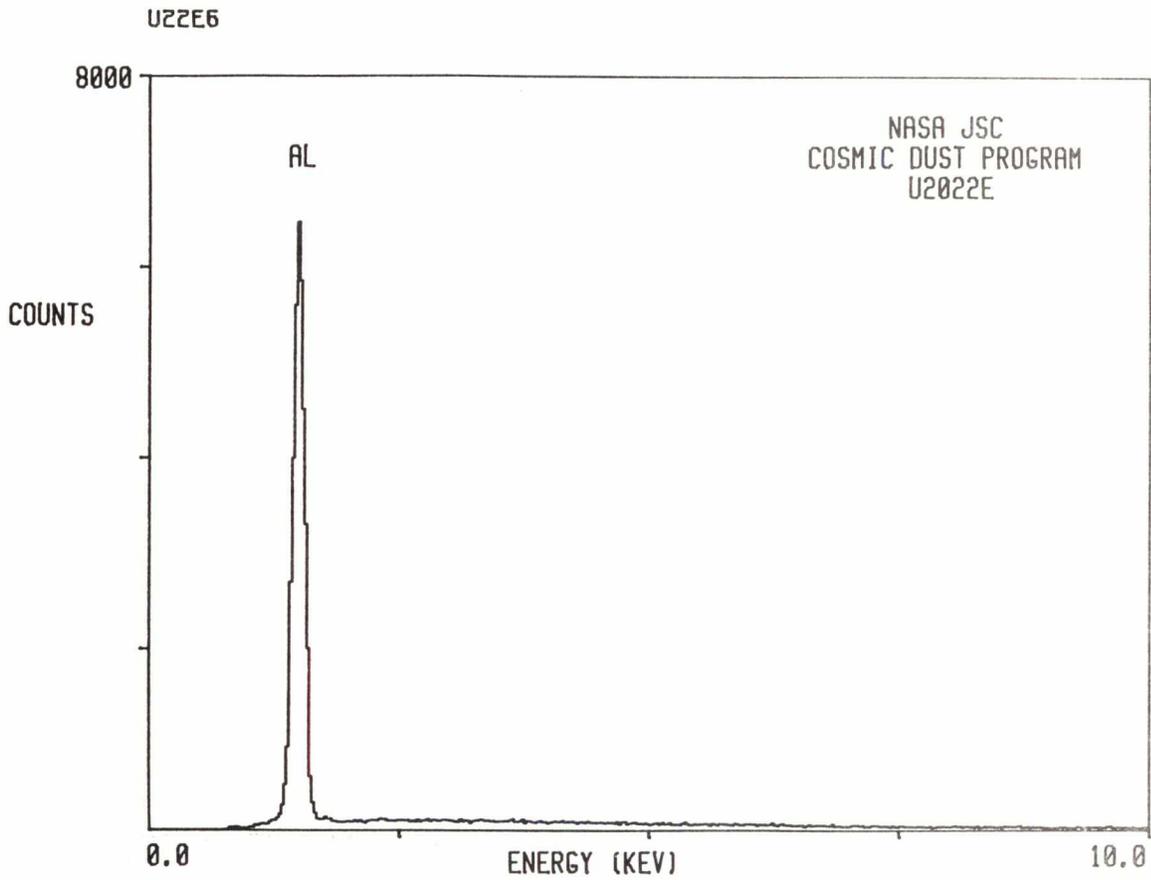
U2022 E 6



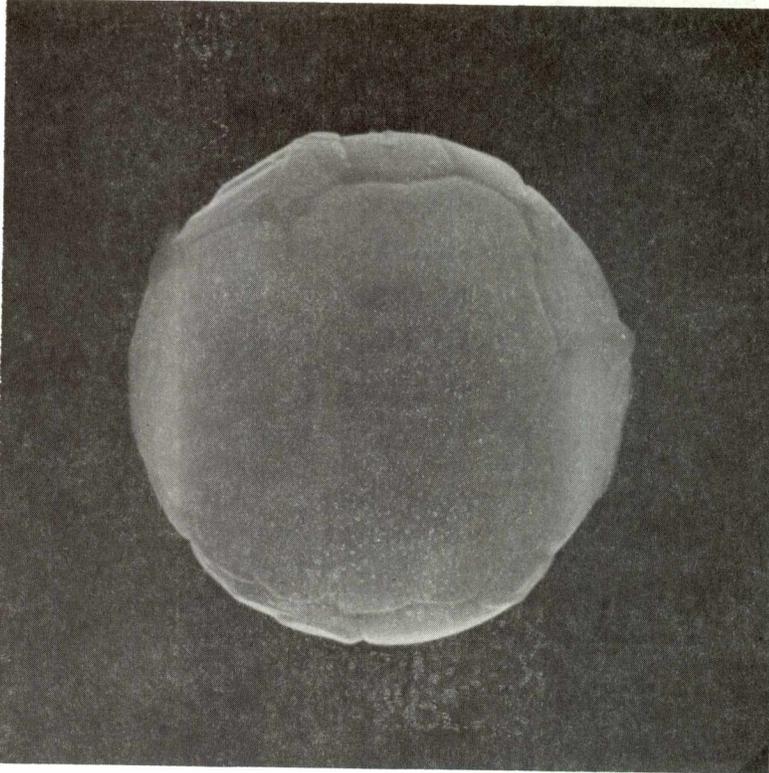
SIZE: 7
SHAPE: S
TRANS.: TL
COLOR: White
LUSTER: SV
TYPE: AOS

COMMENTS:
May be attached to
U2022E27

S-85-42827



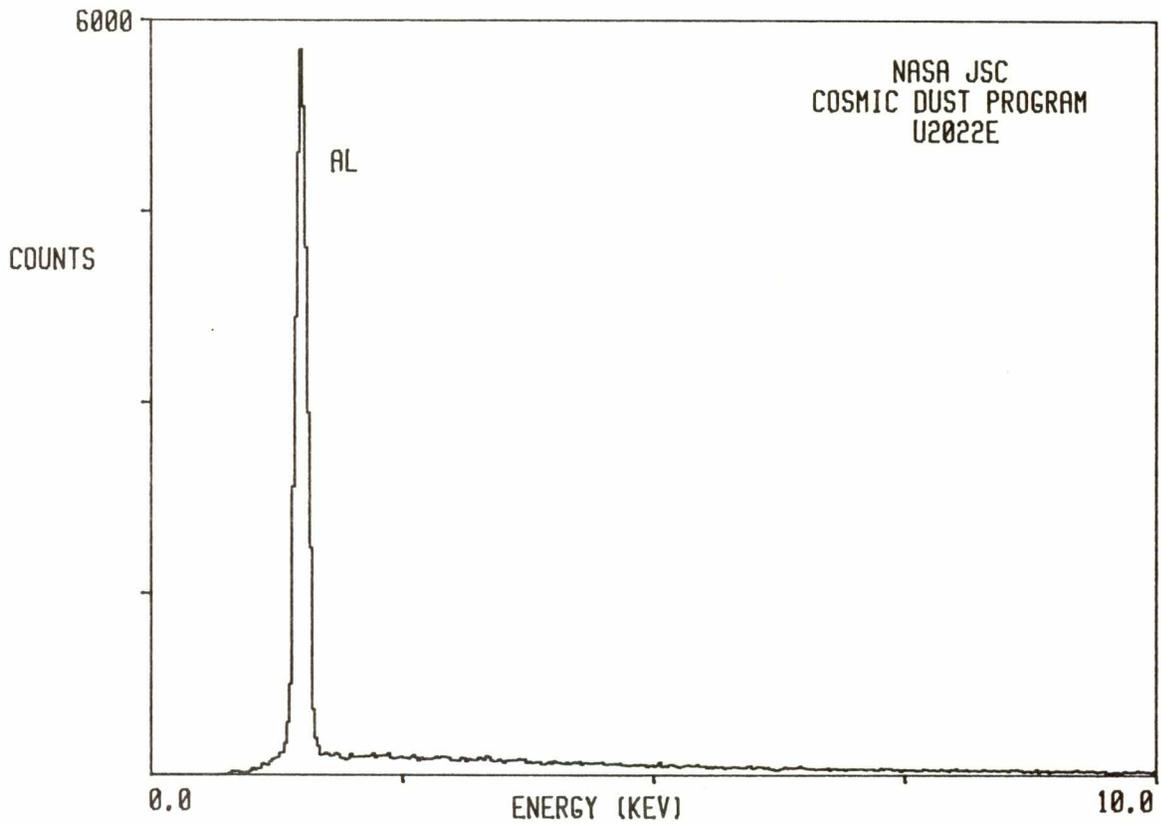
U2022 E 7



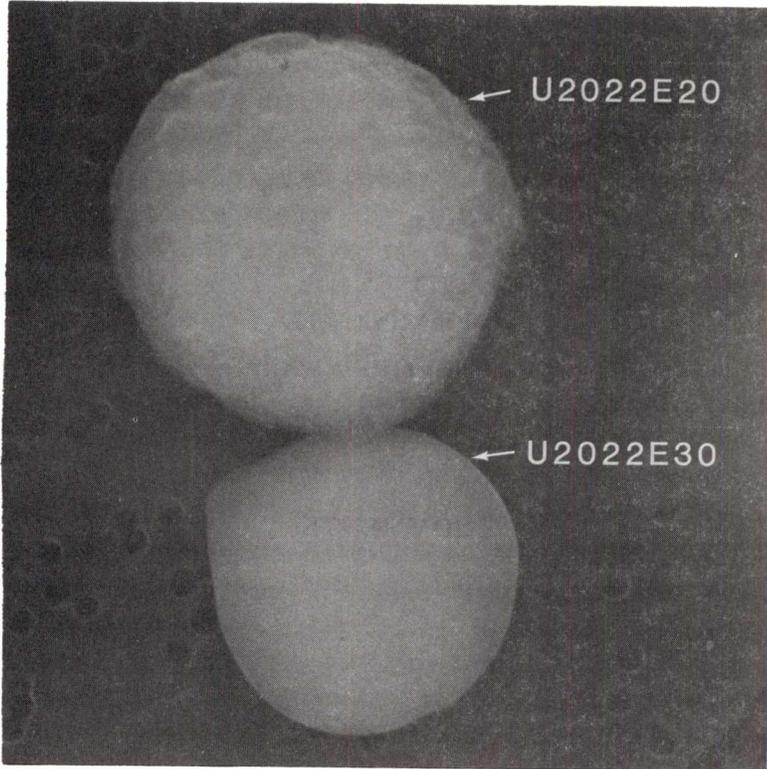
SIZE: 15
SHAPE: S
TRANS.: TL
COLOR: White
LUSTER: SV
TYPE: AOS
COMMENTS:

S-85-42828

U22E7

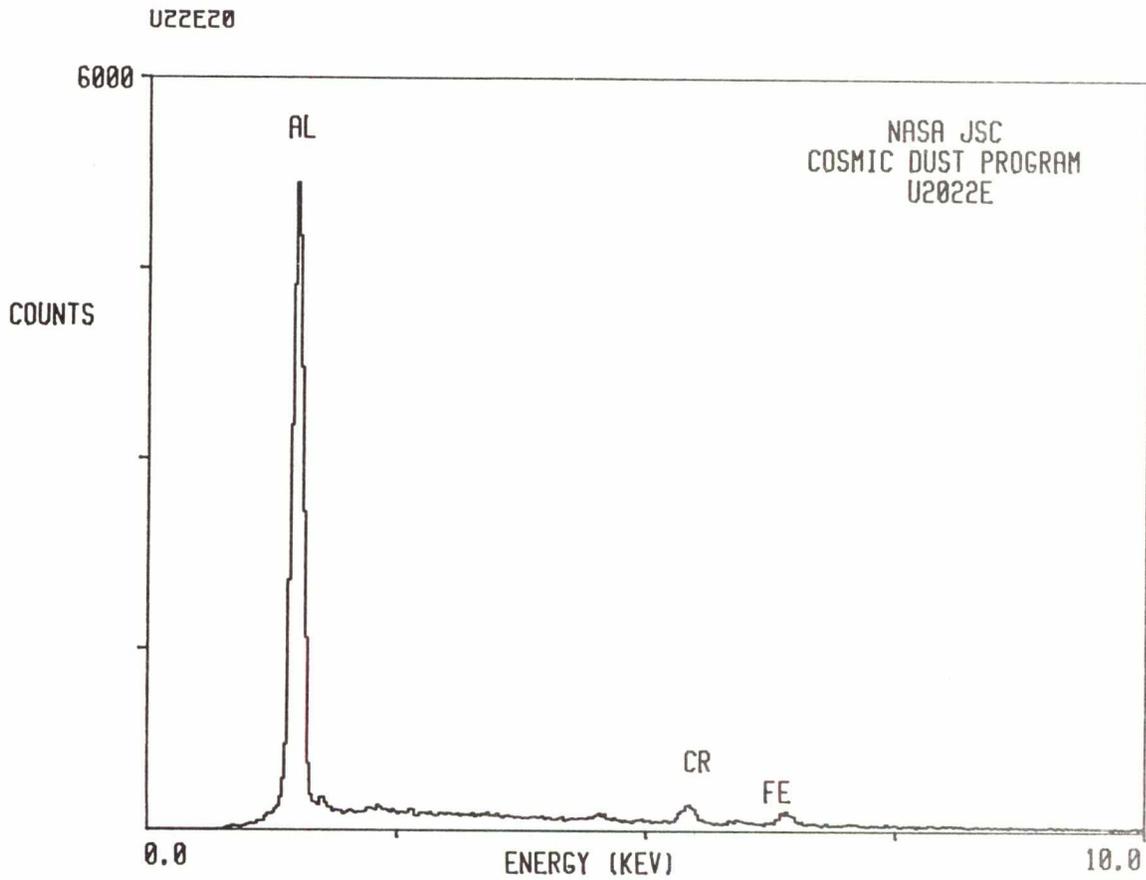


U2022 E 20

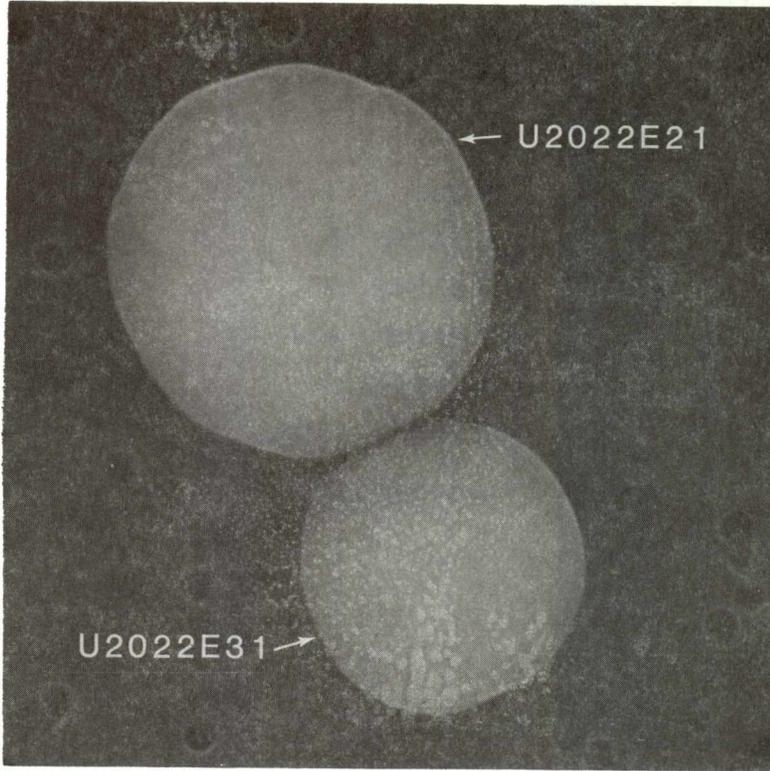


SIZE: 4
SHAPE: S
TRANS.: T
COLOR: Colorless
LUSTER: V
TYPE: AOS
COMMENTS:
Attached to
U2022E30

S-85-42841



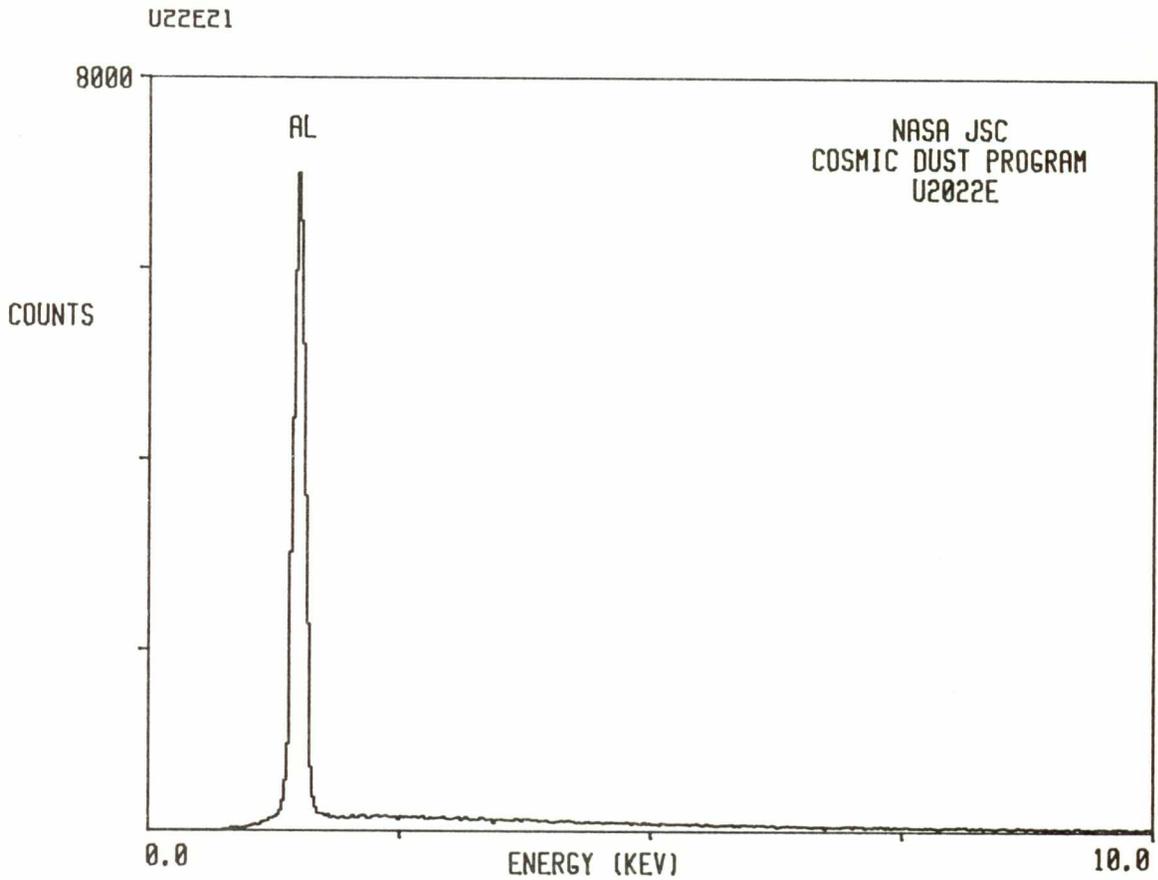
U2022 E 21



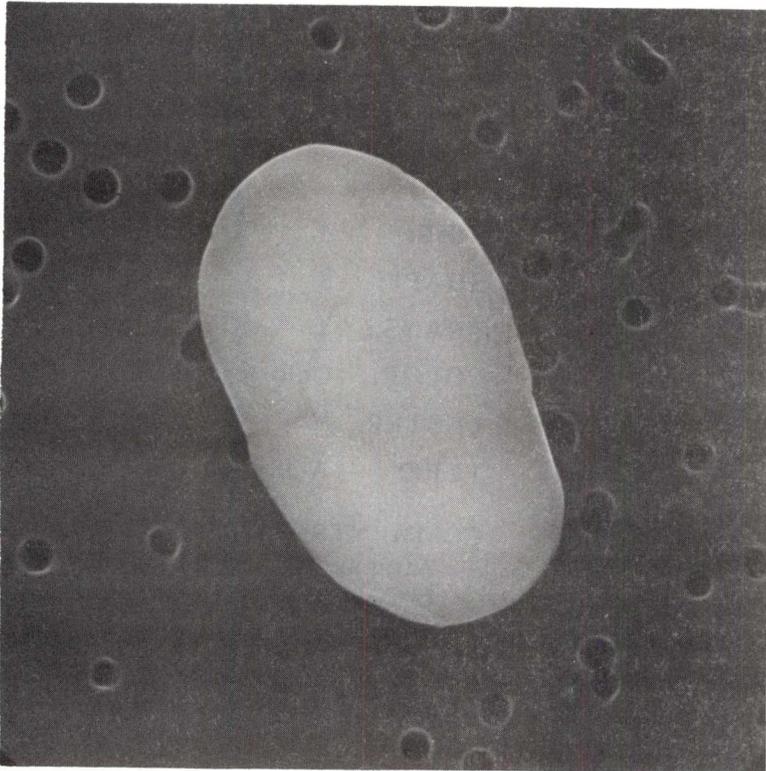
SIZE: 3
SHAPE: S
TRANS.: T
COLOR: Colorless
LUSTER: V
TYPE: AOS

COMMENTS:
Attached to
U2022E31

S-85-42842

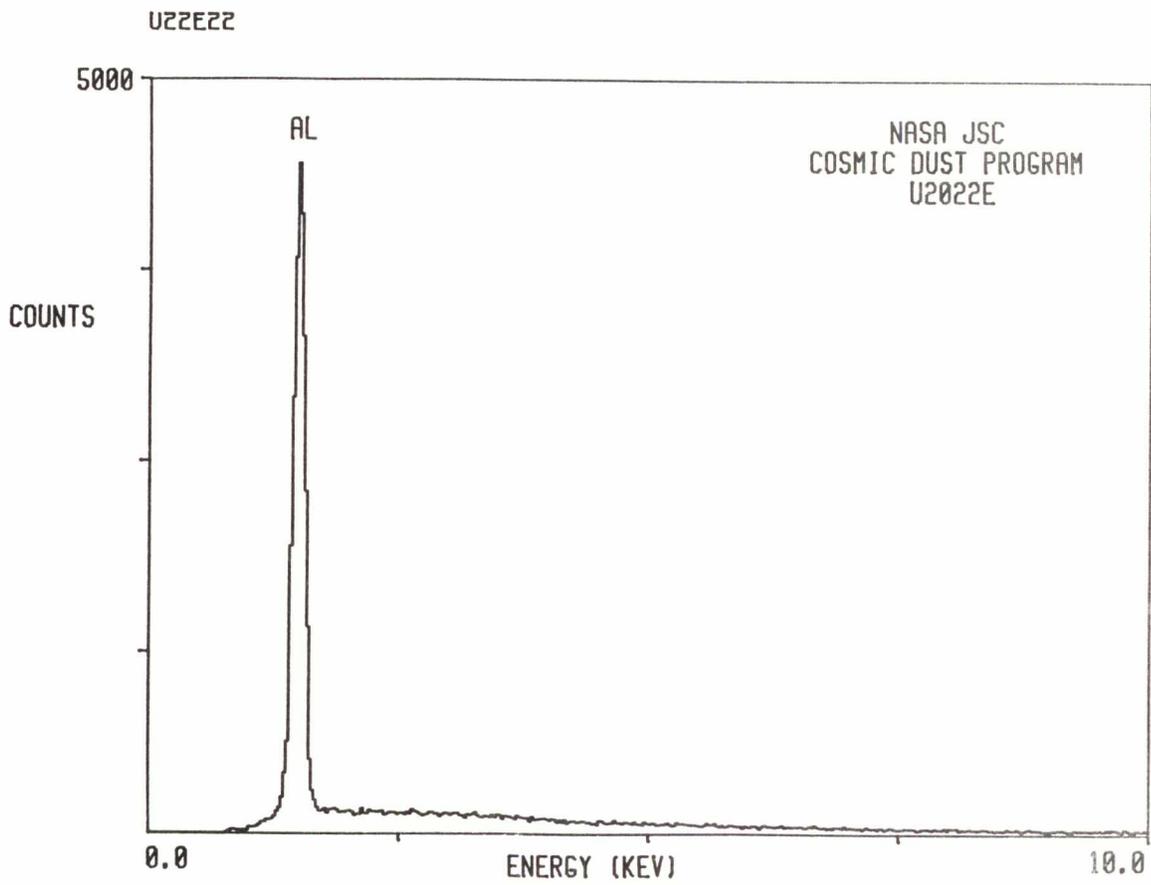


U2022 E 22

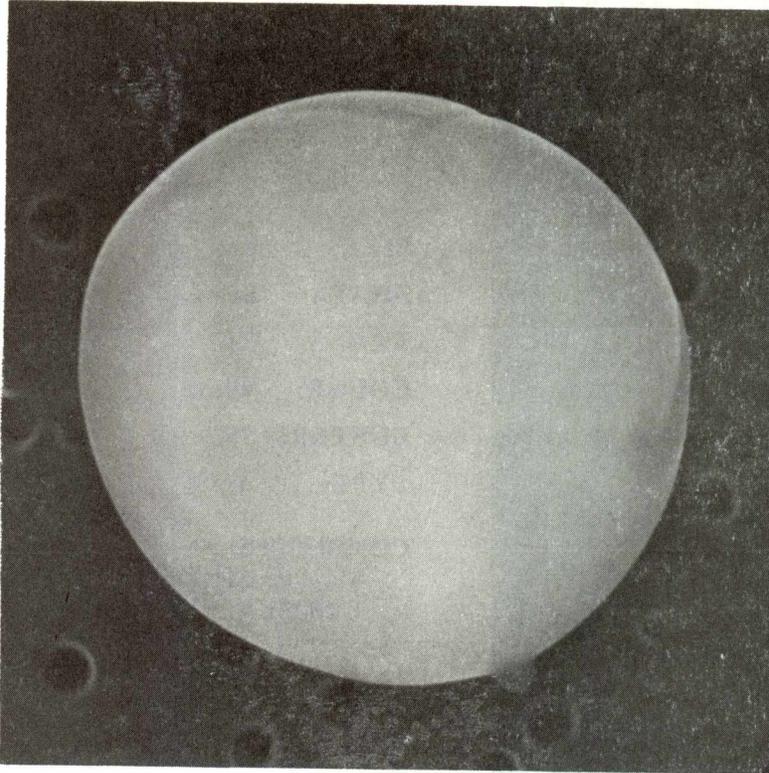


SIZE: 3x2
SHAPE: S
TRANS.: T
COLOR: Colorless
LUSTER: V
TYPE: AOS
COMMENTS:

S-85-42843

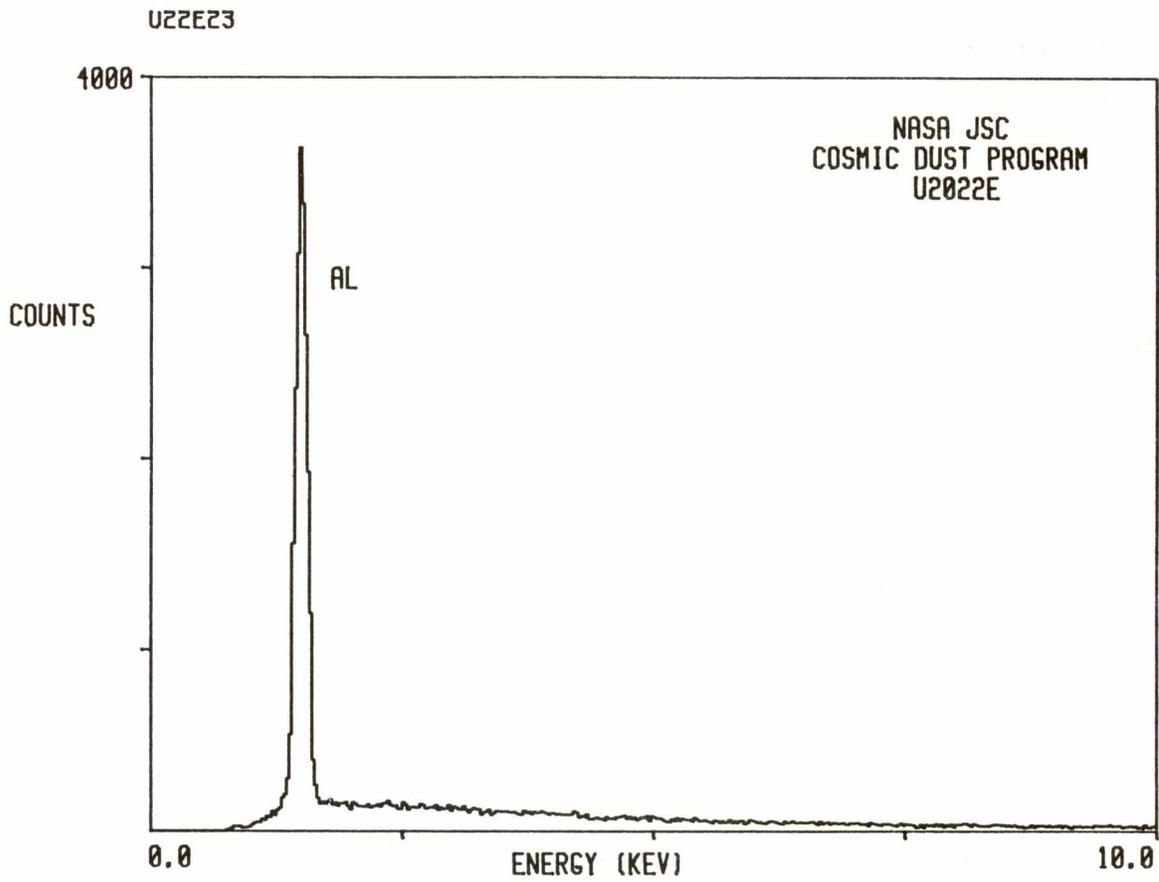


U2022 E 23

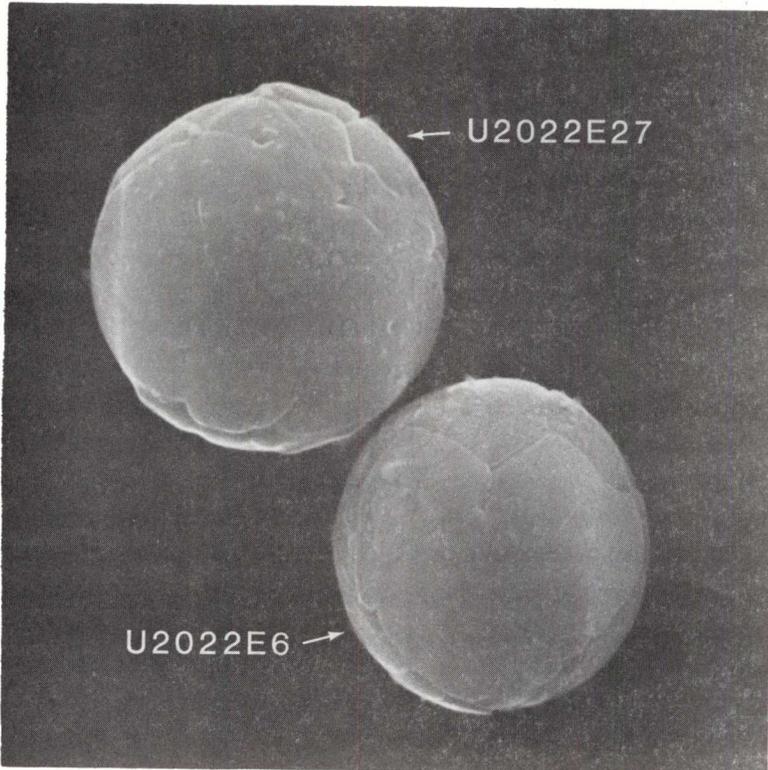


SIZE: 5
SHAPE: S
TRANS.: T
COLOR: Colorless
LUSTER: V
TYPE: AOS
COMMENTS:

S-85-42844



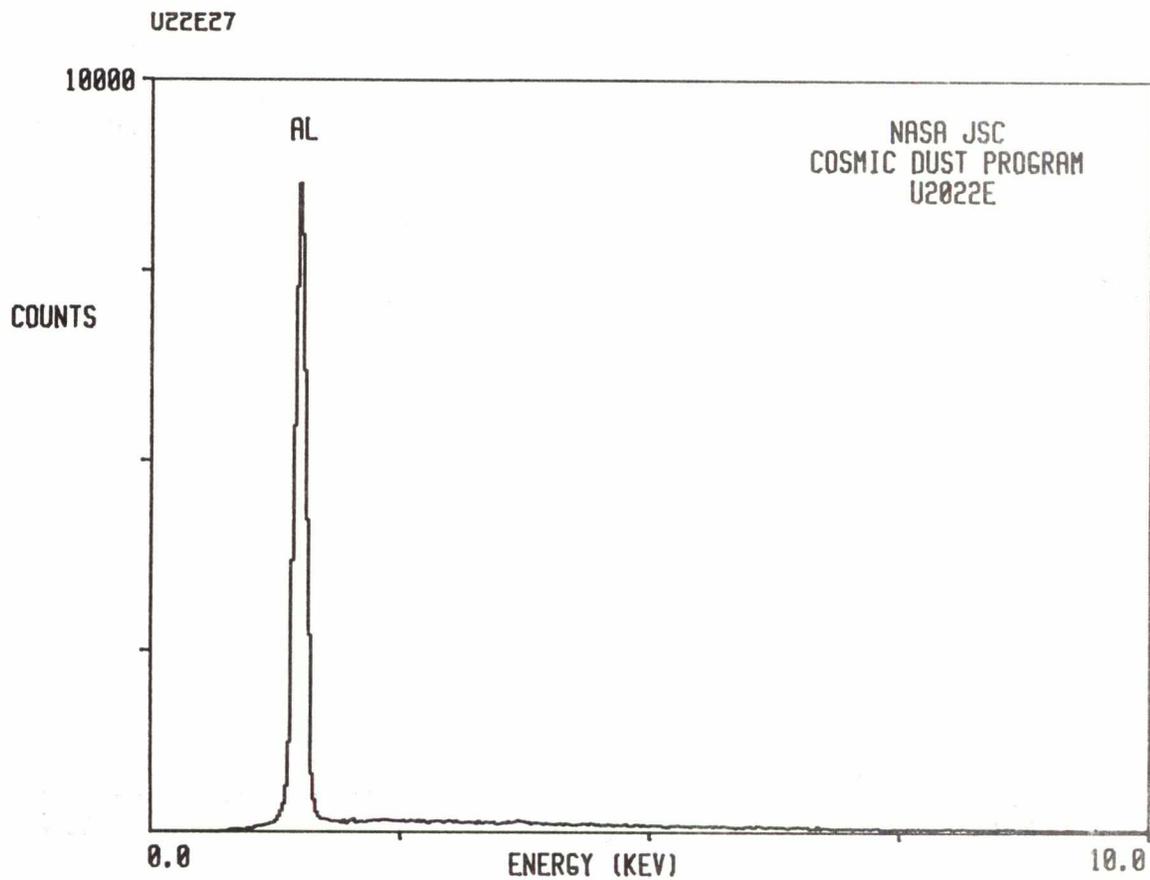
U2022 E 27



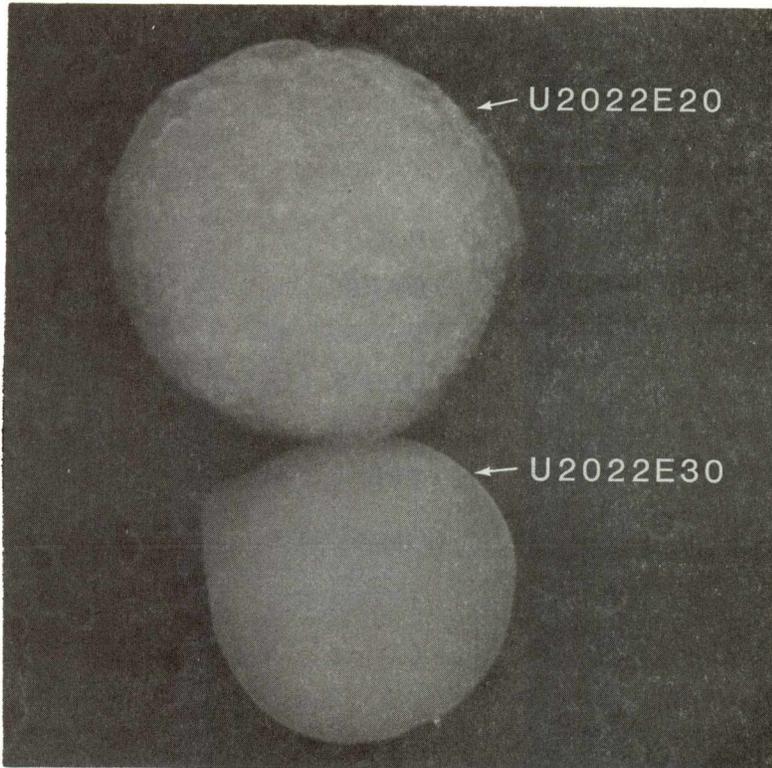
SIZE: 8
SHAPE: S
TRANS.: TL
COLOR: White
LUSTER: SV
TYPE: AOS

COMMENTS:
May be attached to
U2022E6

S-85-42848



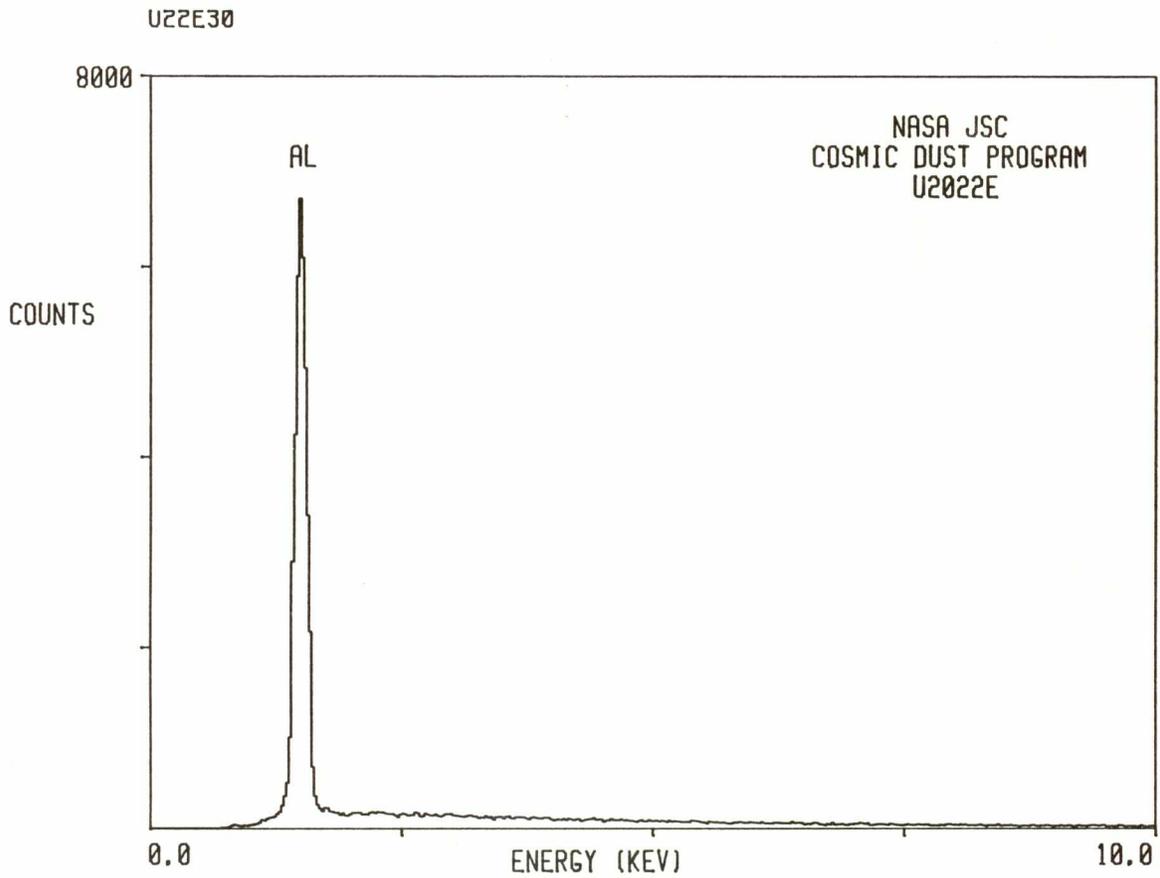
U2022 E 30



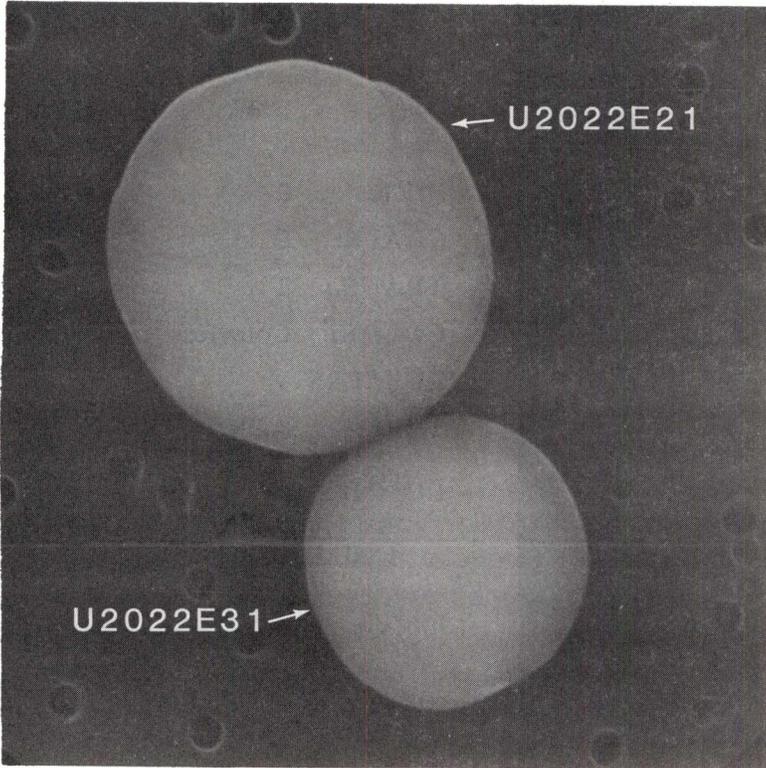
SIZE: 2
SHAPE: S
TRANS.: T
COLOR: Colorless
LUSTER: V
TYPE: AOS

COMMENTS:
Attached to
U2022E20

S-85-42851



U2022 E 31

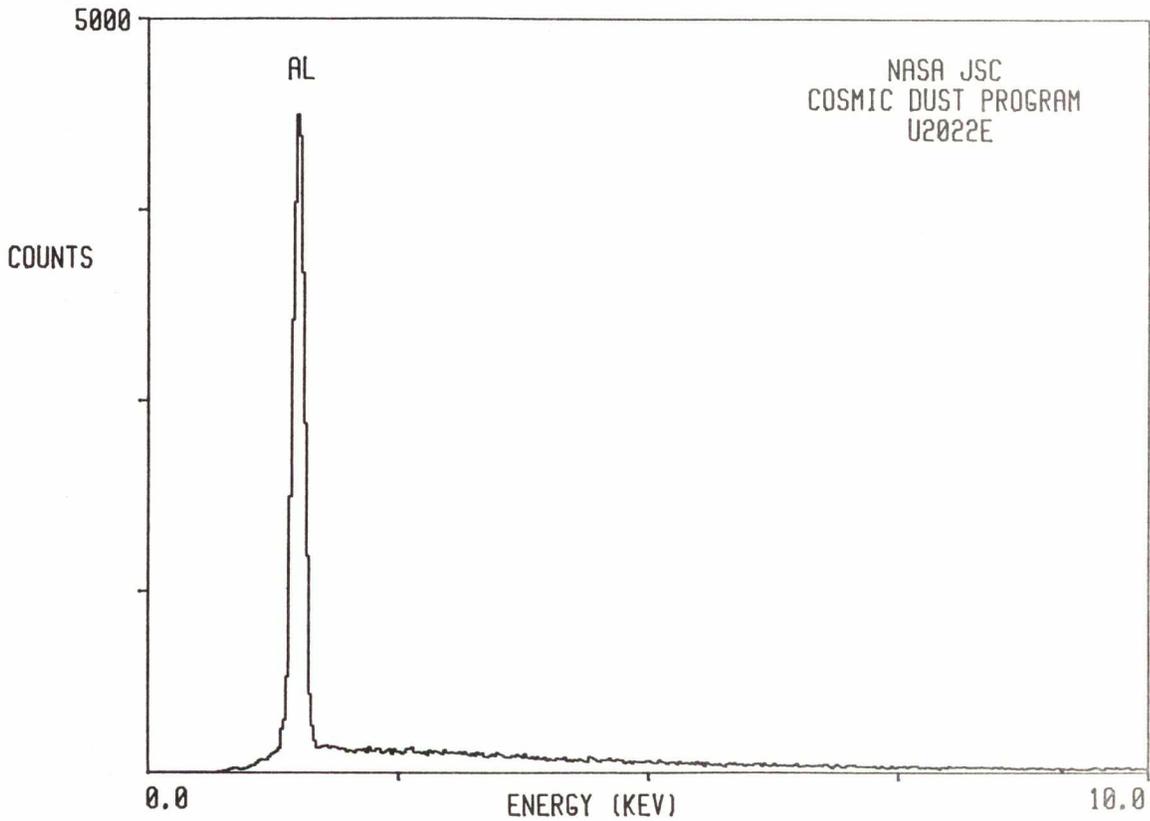


SIZE: 2
SHAPE: S
TRANS.: T
COLOR: Colorless
LUSTER: V
TYPE: AOS

COMMENTS:
Attached to
U2022E21

S-85-42852

U22E31

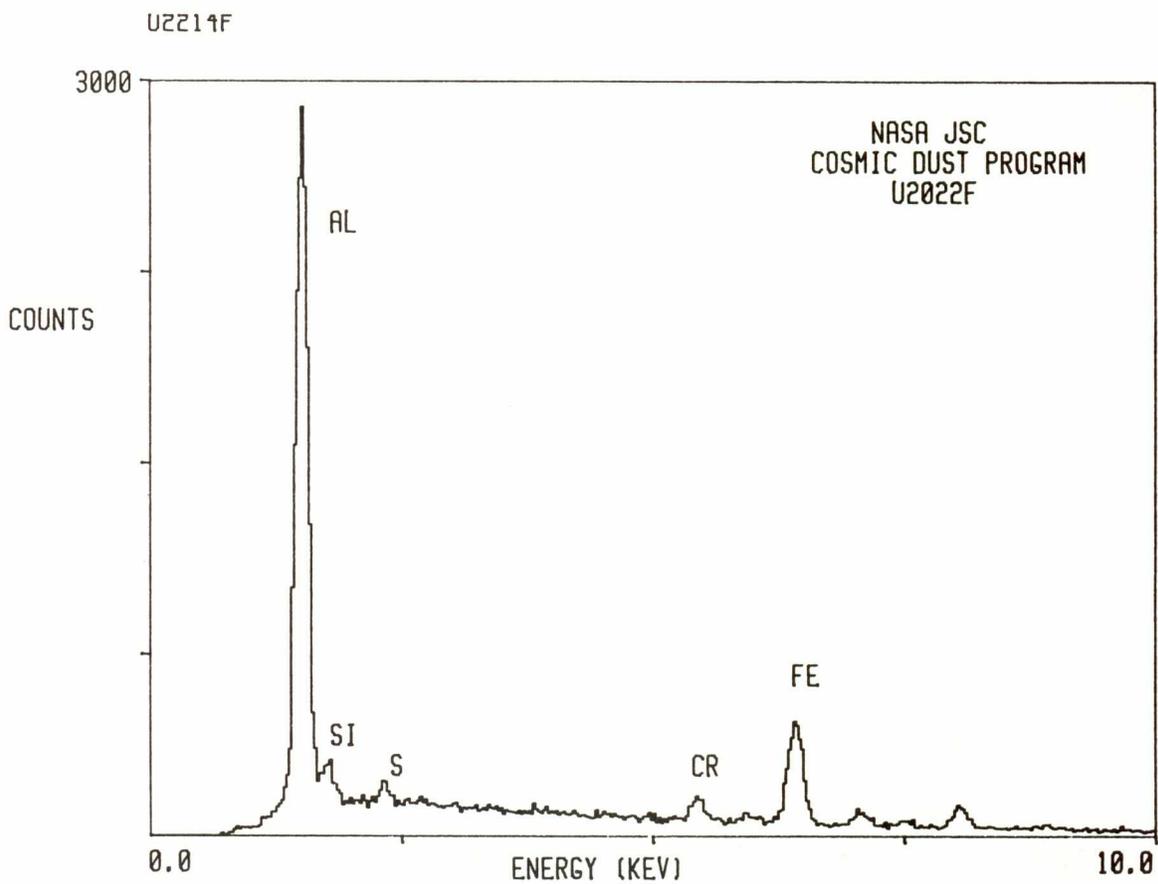


U2022 F 14

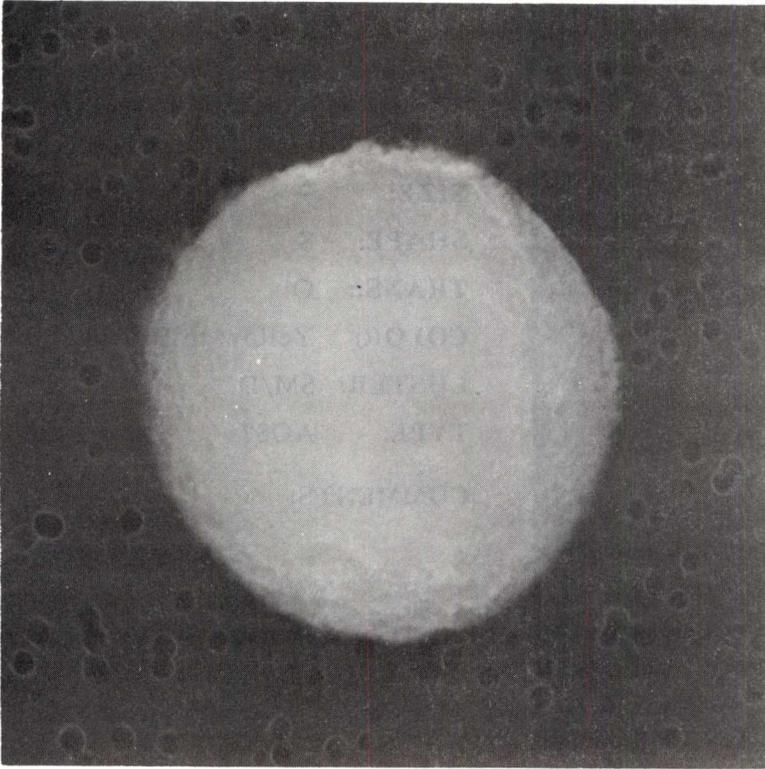


SIZE: 9
SHAPE: S
TRANS.: O
COLOR: Yellow to Brown
LUSTER: SM/D
TYPE: AOS?
COMMENTS:

S-85-42865



U2022 G 12



SIZE: 8
SHAPE: S
TRANS.: T
COLOR: Amber
LUSTER: V
TYPE: AOS
COMMENTS:

S-85-42882

