

COMBINED INFRARED (IR) AND ANALYTICAL ELECTRON MICROSCOPE (AEM)  
STUDIES OF THIN-SECTIONED IDPS. J. P. Bradley, H. Humecki, M. S. Germani,  
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Laboratory infrared transmission/absorption measurements of interplanetary dust have been used for mineralogical classification of IDPs, and for comparison of their spectral properties with those of dust in space [1, 2]. IR measurements have typically been obtained from IDPs that were first pressed into KBr crystals [1]. We have recently obtained IR spectra from thin sections (<100 nm thick) of IDPs using a spectrophotometer designed specifically for micrometer scale analysis. The sections were also characterized in the AEM using both automated and manual data acquisition techniques [3, 4]. This combined analytical approach makes it possible to evaluate laboratory (and astronomical) IR spectra in terms of indigenous properties of IDPs (e.g. silicate mineralogy, grain size, degree of crystallinity, aqueous alteration), which have been rigorously determined from AEM studies.

Thin sections were produced by ultramicrotomy [4]. Some sections were mounted on 3 mm TEM grids and others on diamond plates. The sections on diamond were also oxygen plasma ashed to remove epoxy and other carbonaceous phases. For the IR measurements, some TEM grids were supported on KBr crystals, some on diamond plates, while others were simply mounted over a hole. Sections mounted in these different configurations are necessary to evaluate the influence of epoxy embedding media, copper TEM grids, carbon films, and (KBr and diamond) support substrates on observed IR spectral features. Epoxy dominates the band structure within the 2-8.5  $\mu\text{m}$  wavelength range, but it makes no major contributions above  $\approx 8.5 \mu\text{m}$ .

Figure 1a shows a thin section of the IDP U222B42. Also shown are an Mg-Si-Fe ternary plot of automated AEM point count analyses (Fig. 1b) [3], and a (background subtracted and smoothed) IR spectrum (Fig. 2a) from the same thin section. In Figure 1b, the clustering of most of the (243) data points about an enstatite composition indicates that U222B42 is pyroxene-rich. Figure 2b shows an IR spectrum from a thin section of forsteritic ( $\text{Mg}_2\text{SiO}_4$ ) olivine. Comparison of this spectrum with that of standard forsterite [5] confirms that high quality IR data can be obtained from <100 nm thick sections. In Figure 3, the "10  $\mu\text{m}$  silicate feature" from a section of IDP U219C11 is compared to comets Halley and Bradfield [6]. Although a combination of several classes of IDPs provides a match to cometary IR spectra [1], Figure 3 suggests that a (previously unrecognized) type of anhydrous IDP may provide an even closer match to some comets.

The ability to obtain IR spectra expands the range of non destructive measurements that can be made on ultramicrotomed thin sections of IDPs. As described by Ref. [1] and illustrated in Figures 2 and 3, IDPs exhibit variation in their absorption features. This variation can be correlated with the mineralogy and petrography of IDPs, and be compared directly with IR data from comets.

REFERENCES [1] S. A. Sandford and R. M. Walker *Astrophys. J.*, 291, 838-851 (1985); [2] J. D. Bregman et al. *Astron. Astrophys.*, 187, 616-620 (1987); [3] J. P. Bradley et al. *Earth Planet. Sci. Lett.*, 93, 1-13 (1989); [4] J. P. Bradley *Geochim. Cosmochim. Acta* 52, 889-900 (1988); [5] T. Mukai and C. Koike, *Icarus*, 87, 180-187 (1990); [6] M. Hanner et al. *Astrophys. J.*, 348, 312-321 (1990).

## IR AND AEM STUDIES OF THIN-SECTIONED IDPs: Bradley J. P. et al.

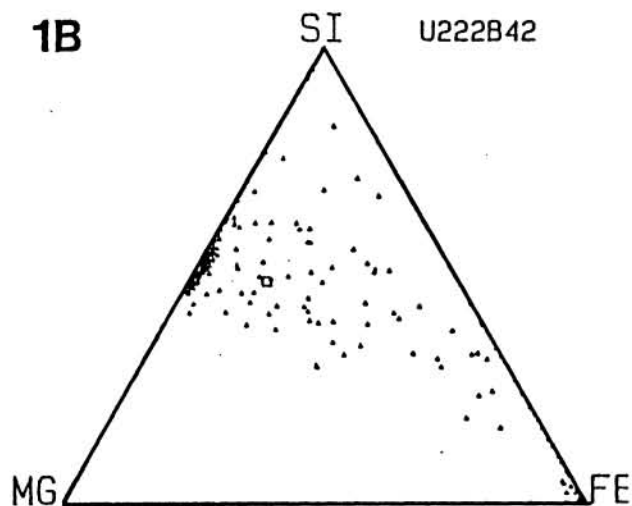


Figure 1 (A) Ultramicrotomed thin section, and (B) ternary plot (atom %) of point analyses of IDP U222B42.

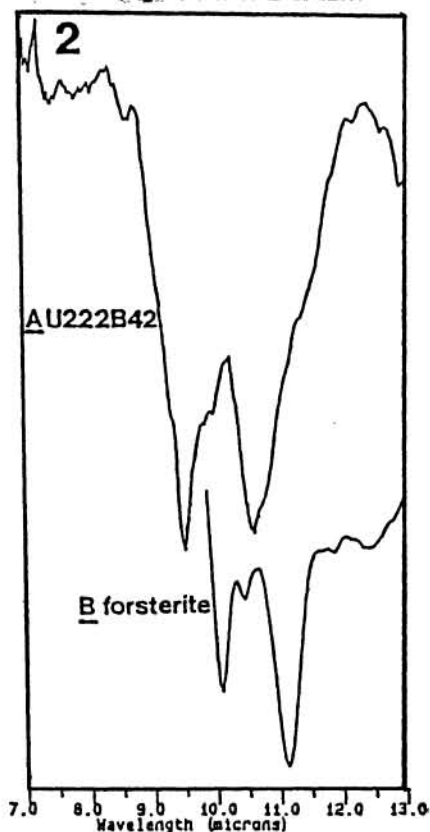


Figure 2 IR spectra from thin sections of (A) U222B42 in Fig. 1A, and (B) olivine.

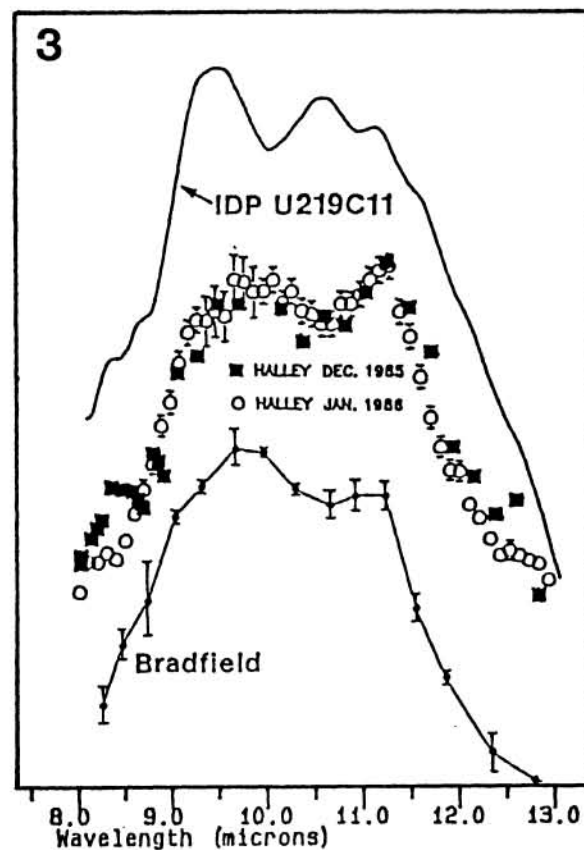


Figure 3 IR spectra from thin sections of anhydrous IDP U219C11, and comets Halley and Bradfield (comet data from Hammer et al. [6]).