

**INFRARED, UV/VIS AND RAMAN SPECTROSCOPY OF COMET WILD-2 SAMPLES RETURNED BY THE STARDUST MISSION.** L. P. Keller<sup>1</sup>, S. Bajt<sup>2</sup>, G. A. Baratta<sup>3</sup>, J. Borg<sup>4</sup>, J. Brucato<sup>3</sup>, M. Burchell<sup>5</sup>, L. Colangeli<sup>3</sup>, L. d'Hendecourt<sup>4</sup>, Z. Djouadi<sup>4</sup>, G. Ferrini<sup>3</sup>, G. Flynn<sup>6</sup>, I. A. Franchi<sup>7</sup>, M. Fries<sup>8</sup>, M. M. Grady<sup>7</sup>, G. Graham<sup>2</sup>, F. Grossemy<sup>4</sup>, A. Kearsley<sup>9</sup>, G. Matrajt<sup>10</sup>, V. Mennella<sup>3</sup>, L. Nittler<sup>8</sup>, M. E. Palumbo<sup>3</sup>, A. Rotundi<sup>11</sup>, B. Wopenka<sup>12</sup> and M. Zolensky<sup>1</sup>. <sup>1</sup>NASA-JSC, Houston, TX 77058, <sup>2</sup>LLNL, Livermore, Ca 94550, <sup>3</sup>Instituto Nazionale di Astrofisica INAF, <sup>4</sup>Institut d' Astrophysique Spatiale, IAS, <sup>5</sup>Univ. Kent, <sup>6</sup>SUNY-Plattsburgh, <sup>7</sup>Open Univ., <sup>8</sup>Carnegie Institute, Wash., <sup>9</sup>Natural History Museum, <sup>10</sup>Univ. Wash., Seattle, <sup>11</sup>Univ. Naples "Parthenope", <sup>12</sup>Wash. Univ., St. Louis. ([Lindsay.P.Keller@jsc.nasa.gov](mailto:Lindsay.P.Keller@jsc.nasa.gov)).

**Introduction.** The Stardust spacecraft collected dust samples of the Kuiper belt comet 81P Wild-2 in aerogel and returned them to Earth January 15, 2006. Preliminary examination (PE) of the collected dust will include teams focused on mineralogy [1], chemical composition [2], isotopic measurements [3], organic analysis [4], cratering [5] and spectroscopic properties. The main PE science goals are to provide an initial characterization of the returned samples with an emphasis on the capture process and its effects on the samples, a comparison of Stardust samples to other meteoritic materials, and the abundance of presolar materials in the Stardust samples.

The science objectives of the Spectroscopy team are to obtain spectroscopic data on Stardust particles through infrared (IR), UV/Vis and Raman measurements of particles in aerogel, extracted particles, kestones, and microtome thin sections. These data will be used to answer fundamental science questions about the nature of the samples, but will also serve as preliminary mineralogical data to guide follow-on measurements that will be performed in the other preliminary examination teams. Because of their non-destructive nature, these spectroscopic measurements will occur early in the PE.

**Infrared Spectroscopy.** Determine the IR characteristics of as many particles or portions of particles as possible in order to ascertain: 1) the nature of the indigenous 3.4  $\mu\text{m}$  organic feature, is it detected and can it be

differentiated/deconvolved from the contaminated aerogel? How does it compare to features observed in interplanetary dust particles (IDPs) and to astronomical measurements of comets and interstellar dust? 2) the shape and fine structure within the 10  $\mu\text{m}$  silicate feature. Overlap with the strong Si-O stretching vibration from the aerogel will complicate this analysis, but we hope to determine if the feature is dominated by amorphous silicates such as those observed in IDPs and comets and whether or not crystalline silicates (e.g. olivine, pyroxene, clays) are present, 3) the presence of secondary (alteration) phases. Deep Impact results suggest that IR observations of Stardust particles should be evaluated for the presence of hydrated materials (water bands at 3 and 6  $\mu\text{m}$ ) and carbonates (6.8  $\mu\text{m}$  and other resonances) and 4) the detection of crystalline features in the far-IR (20-100  $\mu\text{m}$ ) region where crystalline silicates and other minerals have strong bands that can be used both for phase analysis and phase chemistry. It has been demonstrated that these far-IR measurements can be obtained *in situ* on particles in aerogel kestones [6].

**UV/VIS spectroscopy.** Determine the UV/Vis spectrum of extracted particles across the wavelength range from 200–850 nm, in order to observe whether or not there is an absorbance present that can be compared with the 217.5 nm interstellar absorption band; make qualitative analyses of the presence of organic molecules within the grains, and assign bond identities; assess the relative abun-

dances of hydrated and anhydrous minerals within grains on the basis of OH features.

**Raman Spectroscopy.** Obtain Raman spectra from individual extracted particles and from particles in aerogel [e.g. 7-12]. Raman spectra of Stardust particles are expected to be characteristic for both the "disordered carbonaceous materials" (i.e., organic components) and various minerals. The team will try to characterize the nature of the carbonaceous materials (i.e., aromatic, aliphatic, etc.) using the position, width, and relative intensity of the first- and second-order Raman bands. The Raman spectra of most silicates and oxides have very narrow bands, which are strong and very specific for a given mineral. Nevertheless, they potentially can be obscured by the strong Raman bands from carbonaceous materials or by fluorescence effects. As long as the Raman spectra for the minerals can be successfully obtained, however, they will complement and build on the IR data, and they will allow very detailed *in situ* mineralogical analyses of individual Stardust particles and to understand the interaction of the particles with the aerogel from the capture event. Mapping of the particles

will afford some information on the spatial distribution and proportion of phases within larger particles (>3  $\mu\text{m}$ ).

**References.** [1] Zolensky, M. *et al.* (2006) this volume. [2] Flynn, G. J. *et al.* (2006) this volume. [3] McKeegan, K. D. *et al.* (2006) this volume. [4] Sandford, S. A. *et al.* (2006) this volume. [5] Horz, F. *et al.* (2006) this volume. [6] Keller, L. P., Flynn, G. J. and Westphal, A. (2003) *MAPS*, 38, #5288. [7] Burchell, M. J. *et al.* (2001) *MAPS*, 36, 209. [8] Burchell, M. J. *et al.* (2004) *J. Raman Spectroscopy*, 35, 249. [9] Burchell, M. J. *et al.* (2006) Identification of Minerals and Meteoritic Materials via Raman Techniques after Capture in Hypervelocity Impacts on Aerogel, *MAPS*, accepted. [10] Fries M. *et al.* (2004) *LPS XXXV*, #2139. [12] Ferrini, G. *et al.* (2005) Workshop on Dust in Planetary Systems, #4043.

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