

MISASA V “Comprehensive Exploration of the Solar System: Sample Return and Analysis”

Curation and Analysis of Samples from Comet Wild-2 returned by NASA's Stardust Mission

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The NASA Stardust mission returned the first direct samples of a cometary coma from comet 81P/Wild-2 in 2006. Intact capture of samples encountered at 6 km/s was enabled by the use of aerogel, an ultra-low dense silica polymer. Approximately 1000 particles were captured, with micron and submicron materials distributed along ~mm scale length tracks. This sample collection method and the fine scale of the samples posed new challenges to the curation and cosmochemistry communities. Sample curation involved extensive, detailed photo-documentation and delicate micro-surgery to remove particles without loss from the aerogel tracks. This work had to be performed in highly clean facility to minimize the potential of contamination. JSC Curation provided samples ranging from entire tracks to micrometer-sized particles to external investigators. From the analysis perspective, distinguishing cometary materials from aerogel and identifying the potential alteration from the capture process were essential. Here, transmission electron microscopy (TEM) proved to be the key technique that would make this possible. Based on TEM work by ourselves and others, a variety of surprising findings were reported, such as the observation of high temperature phases resembling those found in meteorites, rarely intact presolar grains and scarce organic grains and submicrometer silicates. An important lesson from this experience is that curation and analysis teams must work closely together to understand the requirements and challenges of each task. The Stardust Mission also has laid important foundation to future sample returns including OSIRIS-REx and Hayabusa II and future cometary nucleus sample return missions.