Coordinated Beamforming for metro-area cellular networks with radio backhaul

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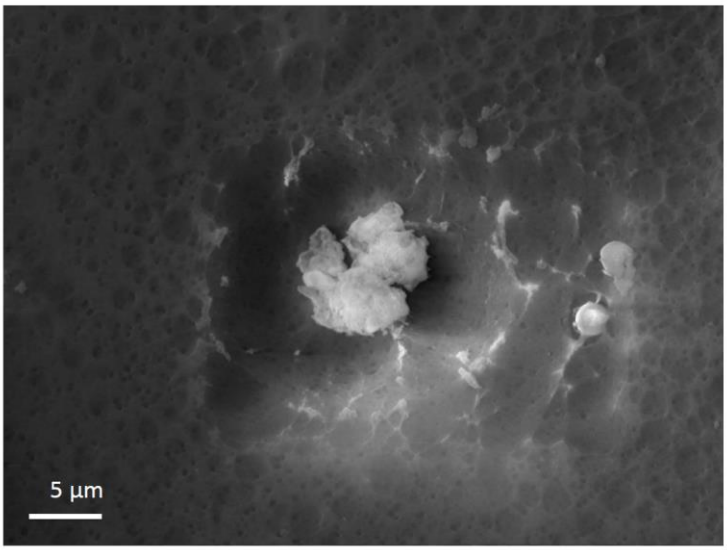
Studying cometary material is critical for determining the origin and evolution of the solar system. In 2006, NASA's Stardust spacecraft delivered to Earth thousands of dust particles collected from the tail of comet 81P/Wild 2 for laboratory study. The samples were the first opportunity to directly study cometary particles of known origin in the laboratory. Stardust cometary particles were collected in a low-density, nano-porous silica aerogel and the particles must be removed from the aerogel prior to analysis. Techniques for extracting sub-1 micron particles and fragments prior to this project were limited. Gas-mediated electron beam induced etching is ideal for direct, nanoscale removal of material including the aerogel medium, however its application to Stardust particle extraction had not previously been studied.

During the course of SIEF funding, and with the support of FEI Company this project produced 8 peer-reviewed publications and 2 patents. SIEF funding also enabled collaboration with Dr. Eric Silver at the Harvard-Smithsonian Center for Astrophysics resulting in experimental verification of the gas-mediated electron beam induced etching process for exposure of Stardust cometary particles.

Overall, this project has developed and characterised a gas-mediated electron beam induced etching based technique for the extraction of Stardust cometary particles from the silica aerogel collection medium. In addition to the study of Stardust particle extraction, the project has also increased the understanding of reaction kinetics of gas-mediated electron beam induced etching of many materials including diamond which are of interest because they affect resolution, processing speed, and shape of fabricated nanostructures.



Test particle extracted from silica aerogel by the gas-mediated electron beam induced etching process developed in this project.