Collection alteration and pristine structural properties of dust particles collected by MIDAS/Rosetta at comet 67P/Churyumov-Gerasimenko

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Comets are believed to have preserved pristine material from the early stages of the Solar System formation, thus providing unique information on intricate processes like dust growth mechanisms. The Rosetta mission gave us the best opportunity to investigate nearly pristine cometary dust particles of comet 67P/Churyumov–Gerasimenko. Among the three in-situ dust instruments, the MIDAS (Micro-Imaging Dust Analysis System) atomic force microscope collected cometary dust particles with sizes from hundreds of nanometres to tens of micrometres and recorded their 3D topography, size, shape, morphology, and related parameters [1].

MIDAS collected dust emitted from comet 67P on dedicated targets. Particles fell through the entry funnel and collided with the collection targets [2] causing an unknown degree of particle alteration. To understand which structural properties of the dust remained pristine and can be used to understand comets and early Solar System processes it is important to understand the collection alteration. Dedicated laboratory experiments were carried out by previous studies [3, 4]. They found that the degree of alteration upon collection is strongly determined by the particle size, strength, and the collection velocity. They indicate that particles in the MIDAS size range deposited with moderate velocities about less than a few metres per second can stick on a target without major alteration.

We aim to determine the structurally least altered MIDAS particles and investigate their properties. As database we use an improved version of the MIDAS particle catalogue [5]. Selecting all particles suitable for our analysis (e.g., cometary origin, sufficiently high image quality) grants us topographic data of over 600 nano- to micrometre-sized dust particles of comet 67P. We create dust coverage maps showing the distribution of the selected dust particles on the collection targets. As first, simple classification we divide the particles into those detected in clusters, suggested to be fragments originating in a shattering event of one large parent particle, and those remote from others that are potentially individually collected particles. Finally, we use a shape descriptor to categorise the particles according to their characteristics, e.g., shape and size, and compare to previous results from COSIMA [6] and simulation/labatory studies [3, 7].