Comets in the lab – How laboratory experiments can help to understand comet formation and activity

B. Gundlach, D. Bischoff, C. Kreuzig, J. Blum

Institut für Geophysik und extraterrestrische Physik, TU Braunschweig, Germany (b.gundlach@tu-bs.de)

In the past years, very successful space missions have significantly improved our knowledge of the origin and activity of comets. These space missions have been supported by a variety of different theoretical models and intensive observational campaigns. However, the support from ground-based laboratory experiments has been limited, although they can provide deeper insights into the physics of comets.

Comets are believed to have formed in the young Solar System by the gentle gravitational collapse of dust clouds, typically consisting of mm- to cm-sized aggregates, mainly composed of non-volatile dust (the dust-to-ice mass ratio is ~4-9). The nucleus apparently consists of intact dust aggregates which have survived the comet formation process, owing to the small impact velocities during the collapse.

The laboratory experiments performed so far were very useful to understand the nature of ice-dust samples under cometary-like conditions. However, since we have now data from several missions, the picture of cometary gas and dust emission has changed. These new insights have changed the requirements needed to carry out state-of-the art comet-simulation experiments with realistic sample materials. Thus, a new generation of ground-based laboratory experiments is required to interpret the data gathered by space missions and to support future space missions to comets, or to other icy bodies in the Solar System.

The objective of our laboratory studies is to investigate the fundamentals of cometary activity by performing experiments with appropriate comet analogue materials, such as aggregates composed of silicate particles, granular H_2O ice and CO_2 ice (see Figs. 1 and 2). With this contribution, we would like to share our latest laboratory results with the community and to start a discussion on the requirements for future laboratory studies.

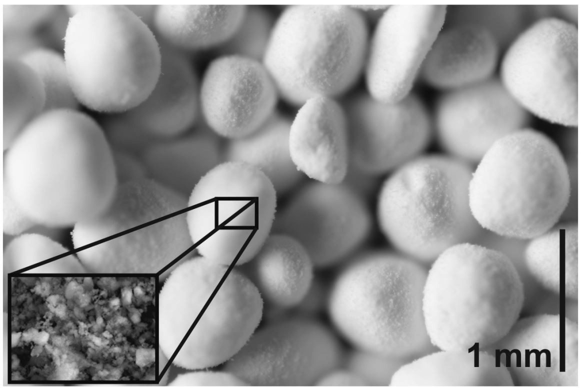

Fig. 1: Image of the mm-sized dust aggregates used in the experiments. The inset shows a SEM image of the micrometer-sized silica particles forming the aggregates.

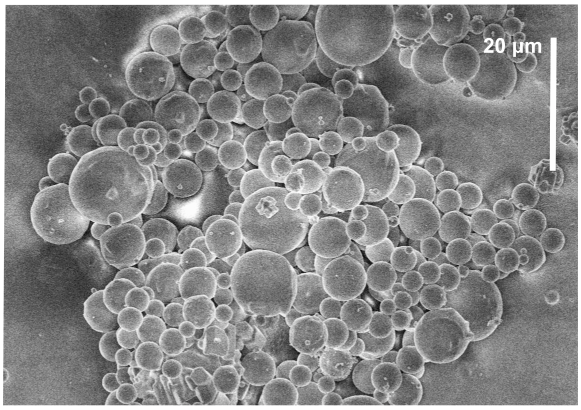

Fig. 2: Micrometer-sized water-ice particles imaged with a cryo-SEM and used for the comet-simulation experiments.