JASMAC
Conference of the Japan Society of Microgravity Appllication
JSMA

S-4

Materials Physics in Space: Recent developments at the German Aerospace Center DLR

Andreas Meyer
Institute of Materials Physics in Space, German Aerospace Center DLR, Cologne, Germany

At DLR research in the field of materials physics under microgravity conditions is devoted to exploration of the fundamental mechanisms that underlie properties of, and solidification processes in metallic liquids in particular, and disordered media in general. Experiments on these systems are often hampered by gravitationally driven phenomena like convection or sedimentation. The challenge is, therefore, to provide experimental techniques under well-defined conditions where accurate and precise measurements of physical quantities become possible.

Research in these areas requires continuous access to microgravity conditions that allows for systematic experimental studies with short turn-around times from idea to experiment. In this context DLR's MAPHEUS sounding rocket program with annual flights has proven to be an extremely efficient microgravity platform for ingenious engineering, comprehensive education of young engineers and researchers, and cutting-edge experiments that can be realized within comparatively short time spans. The knowledge that is based upon methodical work and intense scientific use in laboratory facilities has to be transferred into robust, compact, automated, and reliable flight hardware not only for applications on sounding rockets, but also on recoverable satellites, and at a later step for the International Space Station. This transfer includes the adaptation of elaborate processes, to allow them to be realized under microgravity conditions.

In this presentation the interplay between scientific findings, the development of measurement techniques, and the realization of flight hardware is illustrated with selected flight experiments that cover electrostatic levitation of liquid droplets, in-situ observation of diffusion and solidification processes using X-rays, 3d imaging of granular cooling, differential dynamic microscopy on active colloidal particles, and additive manufacturing from metal powder.