X-RAY CT SCAN OF STRATOSPHERIC MICRON-SIZED DUST PARTICLES: AN ATTEMPT TO A NON-DESTRUCTIVE MORPHOLOGICAL RECONSTRUCTION

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Aerosols and dust are key elements in many mineralogical, geochemical and physical processes. As an example, windblown mineral dust plays a key role in the climate system, and permits evaluation of climate and environmental phenomena. Similarly, interplanetary dusts are the building blocks from which planetesimals accreted in the early solar system lead to the formation of planets, comets and asteroids [1].

We will present in this contribution the status of the physical and chemical characterization of stratospheric micron-sized dust particles with sizes ranging from 0.3 to 20 μm. Collection of uncontaminated dust has been performed by the DUSTER instrument [2, 3] on board of stratospheric balloons flying at altitudes of 35–40 km. Preliminary characterization of grain morphology and size by Field Emission Scanning Electron Microscopy (FESEM), study of the mineralogy and the carbonaceous component by InfraRed (IR) micro-spectroscopy and Raman micro-spectroscopy have been performed at the Cosmic Physics Laboratory of the University of Naples "Parthenope" / INAF-OAC [4]. In addition, a synchrotron X-ray CT scan investigation of two grains from the DUSTER collection with micrometer size have been performed obtaining a full 3D reconstruction of these particles. Indeed, analytical capabilities in mineralogy, geochemistry and physics of organic/inorganic matter has undergone a tremendous development in the last few years, due to the availability of synchrotron-light based microscope-based techniques. Nano-CT experiments were performed with a full-field transmission x-ray microscope (TXM) in the range 5 to 12 keV at the Beijing Synchrotron Radiation Facility (BSRF) operating at 2.5 GeV with an available spatial resolution < 30 nm.

Results show that this non-destructive 3D X-ray imaging technique is unique and ideal to visualize hidden internal structures of these micron-sized grains collected in the stratosphere. Actually, experiments may simultaneously provide a detailed morphological and crystal-chemical characterization of dusts, contributing to the identification of their origin: terrestrial vs. extraterrestrial.

References

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