LABORATORY STUDIES OF THE FORMATION OF INTERSTELLAR DUST FROM MOLECULAR PRECURSORS

CESAR S. CONTRERAS and FARID SALAMA, *Space Science Division, NASA-Ames Research Center, Moffett Field, CA, USA.*

The study of the formation and the destruction processes of cosmic dust is essential to understand and to quantify the budget of extraterrestrial organic molecules. Interstellar dust presents a continuous size distribution from large molecules, radicals and ions to nanometer-sized particles to micron-sized grains. The lower end of the carbonaceous dust size distribution is thought to be responsible for the ubiquitous spectral features that are seen in emission in the IR (UIBs) and in absorption in the visible (DIBs). The higher end of the dust-size distribution is thought to be responsible for the continuum emission plateau that is seen in the IR and for the strong absorption seen in the interstellar UV extinction curve. All these spectral signatures are characteristic of cosmic organic materials that are ubiquitous and present in various forms from gas-phase molecules to solid-state grains and all are expected to exhibit FIR spectral signatures. Space observations from the UV (HST) to the IR (ISO, Spitzer) help place size constraints on the molecular component of carbonaceous IS dust and its contribution to the IS features in the UV and in the IR. Studies of large molecular and nano-sized IS dust analogs formed from PAH precursors have been performed in our laboratory under conditions that simulate interstellar and circumstellar environments. The species (molecules, molecular fragments, ions, nanoparticles, etc...) formed in the pulsed discharge nozzle (PDN) plasma source are detected and characterized with a high-sensitivity cavity ringdown spectrometer (CRDS) coupled to a Reflectron time-of-flight mass spectrometer (ReTOF-MS). We will present new experimental results that indicate that nanoparticles are generated in the plasma. From these unique measurements, we derive information on the nature, the size and the structure of interstellar dust particles, the growth and the destruction processes of IS dust and the resulting budget of extraterrestrial organic molecules.

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