

Laboratory Analysis of Silicate Stardust Grains of Diverse Stellar Origins

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Silicate dust is ubiquitous in a multitude of environments across the cosmos, including evolved oxygen-rich stars, interstellar space, protoplanetary disks, comets, and asteroids. The identification of *bona fide* silicate stardust grains in meteorites, interplanetary dust particles, micrometeorites, and dust returned from comet Wild 2 by the Stardust spacecraft has revolutionized the study of stars, interstellar space, and the history of dust in the Galaxy. These stardust grains have exotic isotopic compositions that are records of nucleosynthetic processes that occurred in the depths of their now extinct parent stars. Moreover, the chemical compositions and mineralogies of silicate stardust are consequences of the physical and chemical nature of the stellar condensation environment, as well as secondary alteration processes that can occur in interstellar space, the solar nebula, and on the asteroid or comet parent body in which they were incorporated.

In this talk I will discuss our use of advanced nano-scale instrumentation in the laboratory to conduct coordinated isotopic, chemical, and mineralogical analyses of silicate stardust grains from AGB stars, supernovae, and novae. By analyzing the isotopic compositions of multiple elements in individual grains, we have been able to constrain their stellar sources, explore stellar nucleosynthetic and mixing processes, and Galactic chemical evolution. Through our mineralogical studies, we have found these presolar silicate grains to have wide-ranging chemical and mineral characteristics. This diversity is the result of primary condensation characteristics and in some cases secondary features imparted by alteration in space and in our Solar System. The laboratory analysis of actual samples of stars directly complements astronomical observations and astrophysical models and offers an unprecedented level of detail into the lifecycles of dust in the Galaxy.