Presolar Stardust in the Solar System

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Presolar grains of stardust are a trace component of primitive extraterrestrial materials, including chondrite meteorites and cometary interplanetary dust particles [e.g., 1,2]. They have isotopic compositions distinct from materials of solar system formation and pointing to an origin in the outflows and explosions of evolved stars. Therefore, they serve as bona fide examples of circumstellar, interstellar, and protoplanetary dust that can be studied in detail in the laboratory. They are typically sub-micrometer in size and a large number of phases have been identified, including a wide range of crystalline and amorphous silicates, SiC, partially graphitized carbon, oxides (e.g., Al_2O_3, $MgAl_2O_4$,TiO_2, FeO), and silicon nitride (Si_3N_4). Because their isotopic compositions reflect those of their parent stars, they provide a unique source of information on stellar evolution, nucleosynthesis, and galactic chemical evolution. Their elemental compositions and microstructures provide a wealth of information about dust formation processes in stars and the interstellar medium. Moreover, because different presolar phases react differently to parent body processes (e.g. asteroidal aqueous alteration and/or thermal metamorphism) their abundances in different extraterrestrial samples can provide information about such processes. This talk will review many examples of how presolar grains can be used as probes of a wide range of astrophysical and chemical processes, with emphasis on recent results enabled by technical breakthroughs in microanalytical research.

[1] Zinner E., 1.4 - Presolar grains, in: A.M. Davis (Ed.), Meteorites and Cosmochemical Processes (Vol. 1), Treatise on Geochemistry (Second Edition, eds: H. D. Holland and K. K. Turekian), Elsevier-Pergamon, Oxford, 2014, pp. 181–213.

[2] Nittler L. R. and Ciesla F. (2016) Annual Review of Astronomy and Astrophysics, 54, 53–93.