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Signatures of Heavy Element Nucleosynthesis in Presolar Grains

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Presolar grains condensed around ancient dying stars that contributed dust from which our Solar System was made. Discovered in the 1980's, these sub-micron to tens of microns-sized pieces of dust are identified on the basis of their highly anomalous isotopic compositions, compared to that of objects that formed in the Solar System. The isotopic analysis of presolar grains in the laboratory provide a unique opportunity to understand the nucleosynthesis reactions that occur in stars and other stellar processes.
Multielement isotope data on individual presolar grains yield tight constraints on various parameters that are used in nucleosynthesis model calculations, such as, nuclear reaction rates etc. Traditionally, light element (C, N, O, Si, Mg-Al, K-Ca, Ti, Fe) isotopes have been used to determine the stellar origins of presolar grains and to classify them. The new generation resonance ionization mass spectrometers that have higher useful yields and improved precision allow us to carry out coordinated heavy element (Ni, Sr, Zr, Mo, Ru, Ba) isotope measurements in presolar grains, on which light element isotope data can also be obtained. The majority of presolar grains studied to date provide evidence that they condensed in either asymptotic giant branch (AGB) stars or core collapse supernovae. A small fraction of grains exhibits signatures that indicate they might originate in novae, born-again AGB stars, J-type stars, and other rare stellar objects. The capability of measuring light and heavy element isotopes in individual presolar grains provides an unprecedented opportunity to understand the various neutron capture processes in the stellar sites that produce heavy elements.
This review will discuss the important results that have stemmed from such coordinated light & heavy element isotopic studies of presolar grains.

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