Characterization of presolar stardust in fine-grained chondrule rims from primitive meteorites

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Primitive solar system materials host small amounts of presolar dust that condensed in the winds of evolved stars or in the ejecta of stellar explosions [e.g.,1]. These 'stardust' grains are distinguished from Solar System material by their highly anomalous isotopic compositions. Recent studies of fine-grained chondrule rims (FGR) in several carbonaceous (CR, CM, C-ungr., CO) [2–4] and unequilibrated ordinary chondrites (UOCs) [5] revealed the presence of abundant presolar material. Here, we present results from a NanoSIMS O-isotopic study of FGRs in several CR, CM and ordinary chondrites, as well as Acfer 094.

Presolar silicate and oxide abundances in FGRs range from 8 to 190 ppm, which is on the same level as in the respective meteorite matrices. For the CRs, UOCs, and Acfer 094, the majority of the grains have a silicate composition, which is comparable to presolar grain populations in other primitive chondrites [e.g., 6]. For the CM FGRs, the average O-anomalous grain abundance is lower than in the CR rims, and the presolar silicate/oxide ratio is ~1. This is significantly lower than in other primitive chondrites, indicating a higher degree of aqueous alteration, resulting in silicate stardust destruction [7]. TEM investigations of FIB-sections from 2 FGRs in the CRs GRA 95229 and MIL 07525 revealed a complex assemblage of sulfides, anhydrous Mg-rich silicates, nearly unaltered Fe,Ni metal grains, organic matter, and minor phyllosilicates, set in an amorphous Fe-rich silicate groundmass. These observations rule out formation by erosion or alteration of chondrules; they are indicative of accretion in the solar nebula prior to parent body formation.

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