THE DISTRIBUTION OF INCLUSIONS IN A SINGLE LARGE PRESOLAR SILICON CARBIDE GRAIN.

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The Murchison LS+LU presolar grain separation fraction contains large SiC grains with sizes above 2 µm [1]. A previous study of this SiC size fraction found two morphological types: irregular to round grains and blocky grains with flat surfaces [2]. We have performed detailed elemental and isotopic characterizations of a single 15 µm x 20 µm SiC grain of the latter type. We used complementary imaging techniques of SEM, NanoSIMS, ToF-SIMS, and Auger spectroscopy to determine the types and distributions of various inclusions in this unusually large SiC grain.

An initial NanoSIMS bulk C and N isotopic measurement of this particle identifies it as a likely mainstream type of SiC grain [e.g., 3] with $^{12}C/^{13}C = 54.1 \pm 0.1$ and $^{14}N/^{15}N = 447 \pm 26$. Subsequent O imaging yielded a low secondary ion signal, but indicated a heterogeneous distribution of numerous sub-micrometer spots with elevated O signals. These spots were clearly correlated with minute inclusions that were brought to the surface and then rapidly consumed by the primary ion beam sputtering. The O isotopic compositions of all spots, as well as the integrated composition of the remainder of the SiC are normal within errors. This indicates that the measured O may not be indigenous to the particle and that the O yield in the vicinity of inclusions may be artificially enhanced, similar to what has been observed in studies of internal grains within presolar graphites [4].

In an effort to determine the nature of the inclusions, we examined the particle with ToF-SIMS, in both positive and negative secondary ion modes, and with scanning Auger spectrometry. The latter technique for high spatial resolution elemental imaging is an ideal complement to NanoSIMS isotopic imaging measurements, because the volume of material analyzed by both techniques is virtually identical [5-7].

Imaging of the surface of the SiC grain showed Ti-V hotspots, which are likely to be TiC inclusions, as has been observed elsewhere [8]. We also observed hotspots of Al and of (not spatially correlated) Ca. Some of the inclusions appear to be correlated with steps or boundaries within the SiC grain structure. We will continue with another round of NanoSIMS measurements to determine the isotopic composition of the inclusions.

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Acknowledgements: Some of the Auger measurements were performed with the PHI 700 demonstration instrument at Physical Electronics in Chanhassen, Minnesota.