

COORDINATED TEM/NANOSIMS MICROANALYSIS OF STRUCTURALLY OR ISOTOPICALLY RARE PRESOLAR SILICON CARBIDES

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Introduction: Submicron- to micron-sized grains of SiC originating from asymptotic giant branch (AGB) stars and supernovae (SN) can be ubiquitous in the matrices of primitive chondrites. Previous work has shown that presolar SiC occurs as three fundamental polytypes or stacking sequences (cubic 3C, hexagonal 2H, and one-dimensionally disordered hexagonal structure designated here ∞ H) along with their intergrowths [1]. It has also been shown that presolar SiC occurs as several isotopic types termed mainstream, A+B, X, Y and Z [2]. We are presently performing coordinated Transmission Electron Microscopy (TEM) and NanoSIMS measurements of individual presolar SiC grains to more fully understand their histories. We report our preliminary results on structurally or isotopically rare SiC grain types.

Results: Suspensions of SiC isolated by acid dissolution from Murchison (KJB residue) [3] were deposited on amorphous C-coated TEM grids. *Importantly*, of the KJ-series size separates, KJB is most representative of the Murchison SiC population since 70% of the Murchison population lies within 0.3–0.7 μ m, characteristic of 90% of KJB grains. The distribution of structure types in KJB is 77.1% (3C), 2.1% (2H), 0.9% (∞ H), 16.6% (3C/2H), 2.4% (3C/ ∞ H), 0.3% (2H/ ∞ H), and 0.6% (3C/2H/ ∞ H).

Nine ∞ H disordered and six 3C/2H/ ∞ H-intergrowth grains that were predominantly ∞ H were mapped by TEM. These grains were relocated and measured by NanoSIMS: 12 (plus 3, from ref. [4]) exhibited mainstream ¹²C/¹³C ratios, 2 were type A+B (¹²C/¹³C = 7 ± 5 and 4 ± 2), and 1 was of type X ($\delta^{29}\text{Si} = -500\text{‰} \pm 50\text{‰}$, $\delta^{30}\text{Si} = -400\text{‰} \pm 50\text{‰}$). Isotopic compositions of ∞ H SiC were roughly similar to the distribution observed for the entire Murchison population (dominated by 3C SiC). This was also the case reported for 42 2H/3C intergrowth SiC grains [4]: 36 Mainstream, 1 type A+B, 1 type Y, 2 type Z, and 2 most likely of type X. Also, during NanoSIMS measurements a type X SiC grain was observed which was subsequently determined by TEM to be 3C SiC with a few small twin domains.

Since SiC polytype formation has been shown in the laboratory to be very sensitive to growth conditions, the fact that presolar SiC of different structural types show roughly similar distributions within each isotopic type suggests that SiC forming regions of AGB stars and SN do not present remarkably different physical conditions. Despite obvious and dramatic differences between AGB stars and SN, SiC apparently condenses under roughly similar pressure and temperature ranges in both sources. This is further supported by our TEM/NanoSIMS results on four SN SiC grains of type X in KJB: 2 were 2H/3C intergrowths [4], 1 was 3C, and 1 was ∞ H. These observations do not exclude that there may be differences in the distribution of SiC structure types (and conditions in SiC forming regions) between AGB stars and SN; rather they suggest any differences will not be large.

References: [1] Daulton T. L. et al. 2003. *GCA* 67, 4743-4767. [2] Meyer B. S. et al. 2006. in *Meteorites and the Early Solar System II*, Lauretta D. and McSween Jr. H. Y. (eds) U. of Arizona Press. [3] Amari S. et al. 1994. *GCA* 58, 459-470. [4] Daulton T. L. et al. 2006. *MetSoc*, 5260.