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METALLIC IRON CONDENSED ONTO TITANIUM CARBIDES WITHIN SUPERNOVA GRAPHITES. T.K. Croat, T.J. Bernatowicz, S. Amari, S. Messenger, and F.J. Stadermann[1], Laboratory for Space Sciences and Physics Dept., Washington University, St. Louis, MO 63130, USA, (tkc@wuphys.wustl.edu).

Introduction: Our ongoing transmission electron microscopy (TEM)-based study of supernova (SN) graphites from the Murchison meteorite [1] has identified a new type of presolar grain, namely pure metallic iron (α-Fe). The iron grains were found attached to TiC grains with well-defined crystallographic orientation relationships, suggesting epitaxial growth of the iron on pre-existing TiC grains. These composite TiC/Fe grains, along with other TiC grains with no attached iron, formed prior to the graphite and were incorporated into the graphite spherule during its growth. The presence of such iron grains in supernova ejecta agrees with astronomical observations of the dust emission spectrum around supernovae [2].

Experiments: Graphite spherules from the Murchison met eorite with anomalous isotopic signatures were characterized using a Cameca IMS3f ion microprobe. The 6 μm diameter graphite spherule in which the TiC/Fe grains were found (KE3e#11), showed isotopic excesses in ^{18}O ($^{16}O/^{18}O$ = 320) and ^{28}Si ($\delta^{29}Si$ = -66 per mil, $\delta^{30}Si$ = -79 per mil), likely indicating a supernova origin. This graphite was embedded in epoxy and sliced using an ultramicrotome. The slices were mounted on copper grids and examined in a JEOL 2000FX TEM, equipped with a NORAN energy dispersive x-ray spectrometer (EDXS).

Results: As seen in other SN graphites [3], TEM analysis of the KE3e#11 graphite spherule showed numerous titanium carbide (TiC) internal crystals (825 ppm of TiC by volume). Most TiCs, although corroded to some degree, still showed faceted growth faces and had an average diameter of ~30 nm. Using EDXS, vanadium (5-12 at. %) and significantly elevated iron (2-9 at. %) were found in solid solution within the TiC phase. In ~15% of the over 100 internal grains examined, an iron sub-grain (of typical size 15 nm) was found attached to one of the TiC faces. The crystal structure of the attached iron grains was confirmed with selected area electron diffraction and micro-diffraction in the TEM. Using the graphite {100} lattice spacing for calibration, the structure was found to be body-centered cubic with lattice parameter 2.87Å, consistent with metallic (α-Fe) iron. EDXS confirmed that these attached grains are nearly pure iron; their spectra show only iron (and less than 1 at. % nickel), along with background elements (C, Si and Cu) from the graphite and the TEM grid. A well-defined crystallographic orientation relationship was found in several cases between the two phases (α-Fe and TiC) in these composite grains, with a BCC (011) lattice plane parallel to a TiC FCC (111) lattice plane. Therefore the grains did not result from the later aggregation of two independently nucleated grains, but rather condensation of one occurred onto the other. Secondary condensation of the Fe onto TiC is most likely, given that TiC is generally more refractory than metallic iron. No iron grains were found without attached TiC, whereas many TiCs were found without attached iron grains; this suggests that heterogeneous nucleation on TiC was required for iron condensation.

References: [1] Amari S. et al. (1995) *ApJ,* 447, L147. [2] Wooden D. (1997) in *Astrophysical Implications of the Laboratory Study of Presolar Materials* (Bernatowicz T. and Zinner E., eds.), p.317, AIP, Woodbury, NY. [3] Croat et al. (2002) *LPS XXXIII*, Abstract #1315.