Probing supernovae from graphite grains from Murchison

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Presolar grains are stardust that formed in stellar outflow or stellar ejecta, and were contained in meteorites. The study of presolar grains in the laboratory has yielded a wealth of information about nucleosynthesis in stars, mixing in stellar ejecta and the Galactic chemical evolution. Presolar graphite grains contain an exotic ^{22}Ne-rich component called Ne-E(L). Bulk (= aggregates of grains) noble gas analysis showed that Ne-E(L) mostly consists of ^{22}Ne from ^{22}Na ($T_{1/2}$ = 2.6 a) with a small amount of ^{22}Ne from asymptotic giant branch stars.

Many low-density graphite grains show isotopic signatures of supernova origin, including Si isotopic anomalies (mostly ^{28}Si excesses, but, in a few cases, ^{29,30}Si excesses), the initial presence of ^{44}Ti, and high ^{26}Al/^{27}Al ratios (up to 0.15). A few grains contain ^{22}Ne from ^{22}Na. The abundance signatures in these grains are a crucial diagnostic for theoretical supernova models to probe stellar physics and nuclear physics uncertainties affecting the simulations. For instance, the production of the radioactive isotope ^{22}Na may be an important benchmark for stellar models In a $15M_{sun}$ model (s15a28c) by Rauscher et al. (2002), ^{22}Na is produced in the O/Ne zone, and the maximum mass fraction in the model is 2.2×10^{-6}. Recently, Pignatari et al. (2015) proposed supernova models including the effect of high shock velocities, and the H injection in the He/C zone. In these models explosive H- and He- burning produces large abundances of ^{22}Na. The largest production obtained is in model 25T-H, with a mass fraction of $\sim 5 \times 10^{-2}$ in the so-called O/nova zone, which is adjacent to the C-rich He/C zone. We will discuss supernova signatures of low-density graphite grains and supernova models with special emphasis on the origin of ^{22}Na.