NATO Advance Research Workshop
Syntheses, Properties and Applications of Ultrananocrystalline Diamond
St. Petersburg, Russia, June 7-10, 2004

Invited Talk

Nanodiamonds in the Cosmos

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Interstellar molecular clouds exhibit infrared emission features characteristic of C-H stretching bands which are attributed to dust grains of H-terminated diamond [1]. Within our solar system, primitive chondritic meteorites (among the most well preserved, least altered, and least metamorphosed material that initially formed in our solar system) contain pristine dust grains that predate the formation of the solar system. Nanometer-sized diamonds are ubiquitous in primitive chondrites at 1-1400 ppm [2], often representing a significant component of carbon in the matrices of these meteorites. Although comparative microstructural studies using transmission electron microscopy indicate the majority of the nanodiamonds formed by vapor condensation [3], their various sources have not been definitely established. The presence of trapped Xe with specific isotopic anomalies (characteristic of explosive nucleosynthesis) in nanodiamond separates from meteorites suggests at least a subpopulation of the nanodiamonds formed in association with supernovae. However, all attempts to isolate that subpopulation have failed and the exact nature of the Xe carriers is not known. Asymptotic giant branch (AGB) carbon stars are a likely source of presolar nanodiamonds based on their pervasive dust production. The available isotopic evidence, although indicating presolar origins for a component of the nanodiamond population, can neither support nor eliminate AGB stars as sources. Similarly, the solar nebula should not be neglected as a possible source since it cannot be excluded by the available isotopic evidence. Microstructural and trapped element isotopic data on meteoritic nanodiamonds are discussed in terms of the origin and formation mechanisms of meteoritic nanodiamonds as well as the information nanodiamonds can reveal about circumstellar/nebular processes.

[1] O. Guillois *et al.*, *The Astrophys. J.*, **521**, L133 (1999).
[2] S. S. Russell *et al.*, *Met. & Planet. Sci.*, **31**, 343 (1996).
[3] T. L. Daulton *et al.*, *Geochim. Cosmochim. Acta*, **60**, 4853 (1996).