Nanodiamonds in the Sky and in the Lab: Surface Chemistry and Ion Implantation Studies

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Diamond nanoparticles (2-10 nm in size) have been found both in some meteorites and in detonation products of explosives about twenty years ago. Ultradispersed detonation diamonds (UDD) are considered mainly as a perspective material for high technology applications. Meteoritic diamonds (MD) are of great interest as a most abundant type of presolar grains carrying the traces of nuclear and chemical processes in circumstellar media. The extremely limited amounts of MD extracted from meteorites for laboratory analysis make difficult the simulating experiments needed for correct interpretation of analytical data and for subsequent elucidation of origin and history of MD in space. Started from the striking similarity of the MD and UDD properties we have used UDDs as synthetic analogs of presolar diamonds in laboratory simulations of cosmochemical relevance. Here we present a review of our results illustrating this exotic “application” of UDD.

The first approach includes the study of surface chemistry of UDDs of various initial properties as analogs of MD in attempt to answer the key question: can any surface features of nanodiamond grains survive the chemical procedure used to extract them from meteorites? Our results revealed that: 1) this procedure does not remove all initial surface features of UDD and 2) surface chemistry of extracted UDD depends on the origin (the details of explosive synthesis) of UDD [1]. The possibility exists, then, to get some information on the surface chemistry of interstellar grains in space studying the meteoritic diamonds. In the second set of experiments using ion bombardment of UDD it was shown that: 1) ion implantation is a viable mechanism for trapping of noble gases in the nanodiamond interstellar grains, 2) the observed isotope fractionation during implantation indicates a need to re-evaluate the composition of supernova components and 3) the measured dose and energy dependences of ion trapping allow to reconstruct the conditions and scenario of implantation events in interstellar media [2].

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[2] A.P. Koscheev et al. *Meteor. Planet. Sci.*, **38**, A85 (2003); A.P. Koscheev et al. *Lunar and Planetary Science,* **XXXIV** (CD-ROM), #1406 (2005).

[3] A.P. Koscheev et al. *Nature*, **412**, 615-617 (2001); A.P. Koscheev et al. *Meteor. Planet. Sci.*, **40**, A87 (2005).