ATOM-PROBE TOMOGRAPHY OF METEORITIC AND SYNTHETIC NANODIAMONDS.

P. R. Heck[1,2], M. J. Pellin[2,3,4,5], A. M. Davis[1,2,3,5], D. Isheim[6], D. N. Seidman[6], J. Hiller[4], A. Mane[7], J. Elam[7], M. R. Savina[2,4], T. Stephan[1,2,3,4], F. J. Stadermann[8,9], X. Zhao[8,9], T. L. Daulton[9,10], and C. Floss[8,9]. [1]Robert A. Pritzker Center for Meteoritics and Polar Studies, Dept. of Geology, The Field Museum, Chicago IL. E-mail: prheck@fieldmuseum.org. [2]Chicago Center for Cosmochemistry, [3]Dept. of the Geophysical Sciences, Univ. of Chicago, Chicago, IL. [4]Materials Science Division, Argonne National Laboratory, Argonne, IL. [5]Enrico Fermi Institute, Univ. of Chicago, Chicago, IL. [6]Northwestern Univ. Center for Atom-Probe Tomography, Dept. of Materials Science & Engineering, Northwestern Univ., Evanston, IL. [7]Energy Systems Division, Argonne National Laboratory, Argonne, IL. [8]Laboratory for Space Sciences, [9]Physics Dept., [10]Center for Materials Innovation, Wash. Univ., St. Louis, MO.

Introduction: Because of their small size (~3 nm [1]) meteoritic nanodiamonds [2] are the least understood component found in acid residue containing presolar grains. Their abundance is higher than for any other presolar grains [2], and the knowledge of their origins is therefore of great interest. Isotope anomalies in trace elements have been observed from bulk analyses of nanodiamond residue (e.g., [2]), but bulk C and N isotopic ratios are normal [3]. This and other observations have led to suggestions that only a small fraction of nanodiamonds is presolar (e.g., [4]). Another possibility is that the anomalies are carried by an associated abundant disordered non-diamond sp^2 C phase [5]. Carbon isotope analyses of individual nanodiamonds would test if $^{12}C/^{13}C$ ratios in any diamonds are anomalous. The atom probe tomograph (APT [6]) is currently the only instrument that can analyze the C isotopic compositions of individual nanodiamonds. The first APT results on Allende DM [7] nanodiamond residue (ADM) were recently presented [8,9]. To correct for a potential instrumental bias, we have now prepared synthetic nanodiamond samples as analytical standards for the APT.

Methods: We used a dual-beam focused ion-beam (FIB) microscope to prepare APT samples of ADM [8]. In another approach, we deposited meteoritic or synthetic nanodiamonds directly on presharpened microtips for APT, and embedded them in a stable matrix using atomic-layer deposition [10] of W or Cu. APT analyses were performed with a Cameca LEAP4000XSi tomograph equipped with a picosecond UV laser [6].

Results: Direct deposition sample preparation eliminates the need for FIB lift-out work and improves sample stability. We succeeded in APT analyses of ADM and obtained well-defined C peaks in time-of-flight mass spectra. Our 3D-tomographic reconstructions exhibit isolated and clustered nanodiamonds. The C isotopic compositions of different APT tips of the same aliquot are identical within analytical uncertainties. At the meeting, we will present more data that will help to address the origin of the diamonds and also present APT data of synthetic nanodiamonds.

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