HETEROGENEITY OF CARBON ISOTOPIC COMPOSITION OF THE ULTRADISPERSE DETONATION DIAMOND

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The research of variations of the carbon isotopic composition in bituminous and kerogen components of meteorites is one of directions for decision of the problem of origin and abundance of the chemical forms of abiogenous organic matter. The carbon isotopic composition of nanodiamond may be used as an indicator of the carbon isotopic composition in protoplanetic nebula. At that, the main questions are number of populations of nanodiamond grains, their origin and the carbon isotopic composition.

For the solution of these questions, we continue investigations of synthetic nanodiamond samples. A purpose of these investigations was establishment of heterogeneity of the meteoritic diamond samples according to their carbon isotopic composition at change of measurement conditions on the element analyzer EA 1110 connected with the isotope ratio mass spectrometer DELTA Plus (ThermoElectron, Germany).

Measuring results of the carbon isotopic composition in two fractions of ultradisperse detonation diamond (UDD) at various temperatures of oxidation are given in this report. Agglomerates of the UDD sample were crushed by zirconium microspheres [1]. This sample was treated by a chloric acid at 220 ^{o}C for removal graphitic carbon and then was separated on fine- and coarse-grained fractions by sedimentation at weak centrifugation (fig. 1). Measurements of the carbon isotopic composition in the aliquots of the UDD-3 and UDD-4 samples have been realized at various temperatures of oxidation in a range from 650 up to 1020 ^{o}C. The results of measurement are given in the tab. and on fig. 2.

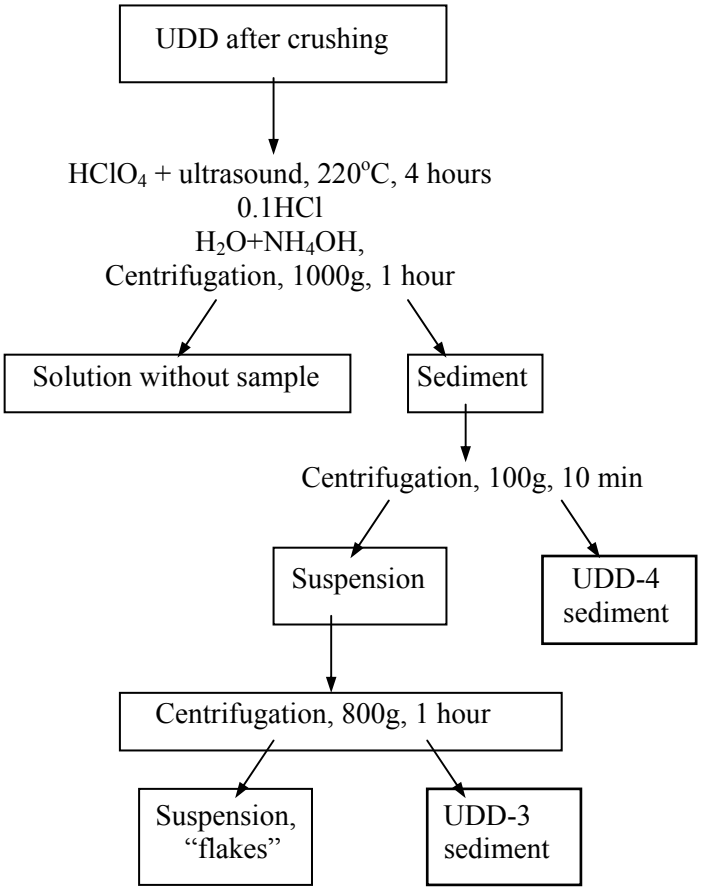

Fig.1. The scheme of processing of the ultradisperse diamond of detonation synthesis (UDD).

Table

The $\delta^{13}C$ values (in ‰) and ratios of signal CO_2 to sample mass (I/M in arbitrary units) during oxidation of the UDD samples

Temperature of oxidation, °C	UDD-3		UDD-4	
	$\delta^{13}C$	I/M	$\delta^{13}C$	I/M
1020	-27.37		-27.45	
900	-27.37		-27.45	
850	-27.40	25.5	-27.42	28.0
830	-27.42	27.4	-27.43	29.3
800	-27.34	31.4	-27.42	31.5
750	-27.33	24.1	-27.51	25.2
750	-27.23	28.5	-27.22	27.1
700	-27.13	1.8	-27.25	7.1
650	-26.68	2.0	-27.10	4.3

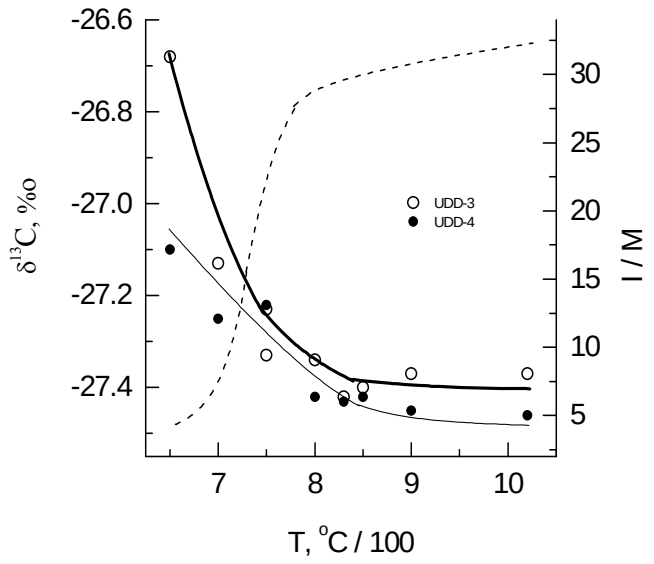

Fig.2. The isotopic composition of carbon released during oxidation of UDD-3 (the open symbols, thick line) and UDD-4 (the closed symbols, thin line) at various temperatures. The dotted line shows change of the signal/mass ratio

According to these data, it can be seen the following:

(1) At temperatures of oxidation less than 750 °C, the ratio of a signal/mass (I/M) sharply decreases, that point to essential reduction of completeness of the sample oxidation. The released carbon in this case becomes heavier;

(2) Almost for all temperature stages of carbon oxidation, the UDD-3 sample has higher $\delta^{13}C$ values in comparison with that for UDD-4 carbon. Especially, this effect is significant at low temperatures of oxidation.

Thus, analysed UDD grains have basically homogeneous carbon isotopic composition except for a surface layer. This layer is slightly enriched by the ^{13}C owing to probably isotopic fractionation. Probably also, fine grains of the analysed UDD have mainly higher contents of ^{13}C, than coarse ones.

These conclusions are in agreement with our earlier conclusions [2]. So, it is possible to assume that at synthesis of the nanodiamond in the extremely nonequilibrium conditions similar to those at

detonation synthesis, it is necessary to expect the increasing the ^{13}C content in surface layers of the diamond grains as well as in the finest grains.

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