INTERACTION OF CRYSTALLINE AND AMORPHOUS FULLERENES WITH HYDROGEN, PARAFFIN HYDROCARBONS AND THEIR DERIVATIVES

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To investigate a possibility of creation of systems of the safe storage of combustible gases and fluids the interaction of hydrocarbons and their derivatives with the fullerene C_{60} and nanotube powders was studied. The complexes production was performed by diffusion introduction of the molecules of methylene chloride (CH_2Cl_2), chloroform ($CHC1_3$), carbone tetrachloride (CCl_4), hexane (C_6H_{14}), heptane (C_7H_{16}) and octane (C_8H_{18}) into the space between fullerene molecules.

The structure of the fullerene compounds with non-aromatic petrol components was studied by neutron and X-ray diffraction. It was observed a appearance of additional superstructure peaks in the fcc crystal lattice of the pure C_{60}. This suggests the creation of interstitial superstructures with the Lifschiz's wave vector. The possible super-structures were analyzed in the frame of the concentration wave theory. It was shown that the compounds are stable for a time from several days to several weeks at the room temperature. At heating to 100 ^oC the compound lose hydrocarbons.

It was detected creation of isomorphic compounds of the approximate composition $C_{60}{\cdot}2CCl_4$, $C_{60}{\cdot}2CHCl_3$, which have the simple hexagonal crystal lattice with the lattice constants a = 10.12 Å, c = 10.64 Å for $C_{60}{\cdot}2CCl_4$ and a = 10.01 Å, c = 9.94 Å for $C_{60}{\cdot}2CHCl_3$. The ratio c/a increases at substitution of hydrogen by Cl.

Stability of the synthesized compounds was investigated and it was shown that the $C_{60}{\cdot}2CCl_4$ samples loses CCl_4 near completely after holding during several weeks transforming into the nearly pure C_{60} with the slightly increased lattice parameter. In $C_{60}{\cdot}2CHCl_3$ only some changes of diffraction reflex intensity are observed whereas $C_{60}{\cdot}2CH_2Cl_2$ remains full stable even after holding during several months. All compounds lose hydrocarbon molecules at temperature increasing to 80 ^0C. The obtained results show that the compound stability increases with hydrogen content increasing.

Interaction of the nanotube samples with the methane halogen-derivatives was studied and it was obtained the marked change of the diffraction pattern as the result of the interaction. These changes are expressed in a appearance of a galo at $\sin\theta/\lambda=0,1$ which disappears during holding of the sample at the room temperature during several hours and of a additional peak at d=3,41 Å which is conserved at heating of the sample to 200 ^0C. It may be supposed that these changes account for interaction of molecules with different sample constituents – the graphite and nanotubes.

Samples of amorphous fullerenes were produced by application of the mechano-activation treatment (milling in a ball mill) and their structure and sorption properties were investigated. By neutron diffraction method it was observed that amorphization comes after milling during two days (fig.1). In the process the hydrocarbon (heptane and others) absorption sharply increases in reference to a crystal powder. Structure stability of amorphous fullerenes against temperature and pressure action was studied.

The other method of amorphous fullerenes production – the radiation amorphyzation-was investigated. Structure changes during annealing of samples amorphyzated by reactor radiation with the fluence up to 10^{19} were determined.

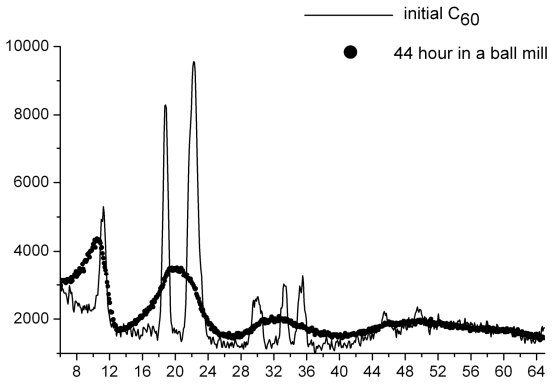

Fig.1. Amorphization of fullerenes after ball-milling

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