

---

---

## **Last results in neutron scattering research of carbon nanostructures**

Aksenov V.L.

*Russian Research Center Kurchatov Institute, pl. Akademika Kurchatova 1, Moscow, 123182  
Russia*

*Joint Institute for Nuclear Research, Joliot-Curie 6, Dubna, Moscow reg., 141980 Russia*

The applications of the neutron scattering methods including small-angle neutron scattering (SANS) and neutron reflectometry (NR) in the research of carbon nanostructures in bulk and at interfaces, are reviewed. One of the most important advantages of the used thermal neutrons (wavelength 0.1-1 nm) is related to the possibilities of the contrast variation based on the isotopic substitution of various elements for regulating the contrast between different components of the studied system. Especially it concerns hydrogen-containing materials, if one takes into account a significant difference in the scattering properties of hydrogen and its isotope deuterium. This determines the classes of materials with carbon nanostructures for which neutron scattering can be used in the most effective way.

First, examples of the SANS applications in various solutions of carbon formations are given. They include molecular and colloidal solutions of fullerenes in non-polar and polar solvents, liquid dispersions of nanodiamond and carbon black, colloidal solutions of carbon-containing composite nanoparticles. The cluster formation, growth and stabilization in these systems are discussed. The comparison of particle structures in solutions and initial powders are made.

Second, the investigations of various thin carbon films (amorphous carbon, nanodiamond) by means of NR are presented. The prospects for studying composite materials with carbon inclusions (e.g. carbon black or nanodiamond in rubbers) with the use of SANS and NR are considered.

The place of neutron scattering methods in complex investigations of carbon nanostructures comprising different complementary techniques, as well as theoretical approaches, is emphasized.