INVESTIGATION OF FULLERENOLS AND ENDOFULLERENOLS SELF-ASSEMBLY IN AQUEOUS SOLUTIONS BY THE NUCLEAR PHYSICS METHODS

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Biomedical applications of fullerenes come from their unique structure and physicochemical properties diversified in derivatives. Recently at PNPI there were synthesized and investigated new endofullerenes capturing paramagnetic atoms of 4*f*-metals (from praseodymium to thulium, atomic numbers $Z = 59–69$) for topic applications as contrast agents in Magneto-Resonance Imaging or carriers of nuclear isotopes. It was very important to conduct a comprehensive analysis of their water-soluble forms' behaviors in solutions under particular conditions (temperature, concentration, pH-factor) existing in living organisms. It becomes possible due to nuclear physics methods such as small-angle Scattering, Magneto-Resonance Imaging and others.

Here we presented the results of systematic structural analysis of water-soluble derivatives of fullerenes and endofullerenes in aqueous solutions. Hydroxyl derivatives of fullerenes $C_{60}(OH)_{30}$ and $C_{70}(OH)_{30}$ and endohedral fullerenes with rare earth elements have been studied by small-angle neutron and *X*-ray scattering, dynamic light scattering as well as by atomic force microscopy. In aqueous solutions their three-level structural organization was detected as dependent on the concentrations and pH-factor. There were observed various forms of fullerenols and endofullerenols self-assembly that includes tiny molecular groups of molecular size integrated into more extended aggregates and superstructures in the range of ~1–100 nm (aggregation numbers $\leq 10^4$). The analysis of the influence of external and internal parameters allowed formulating physical criteria of solutions stability and qualitative differences for fullerenols and endofullerolenols systems. The magnetic and electric dipole moments induce dipole-dipole interactions which contribute to more densely packing the endofullerenols molecules in globular aggregates. The obtained structural results possess an undoubted practical importance assuming the prospects of biomedical applications of fullerenes and their water-soluble derivatives.

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