Poster session II

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Insight into multishell carbon nanostructure electrostatic response

O. Sedelnikova, L. Bulusheva, A. Okotrub
Nikolaev Institute of Inorganic Chemistry, Russia

Diversity of carbon nanostructures determines variety of technological usage of carbon-based materials. Polymer composites providing effective absorption of electromagnetic radiation are the most perspective field of applications of multishell carbon nanostructures, such as carbon nanotubes and onion-like carbons. However, in spite of abundance of theoretical and experimental investigation of electromagnetic properties of mentioned above materials, today there is no clear understanding of the role of inner layers and screening effect in multishell carbon nanostructures. Here we present investigation of electrostatic response of multishell carbon onions, including experimental measurements of low-frequency characteristics of composites with onion-like carbons and calculations of static polarizability of two- and three-layer carbon onions using different approaches. Our theoretical data revealed that static polarizability of mutlishell fullerene structures depends on both calculation method (DFT or semiempirical) and basis set. On the example of the models Ar@C60 and C60@C240 we demonstrated that the screening coefficient correlates with strength of non-covalent interlayer interactions. Approximation of low-frequency dielectric permittivity of onion-like carbon-based composites by the Maxwell-Garnett model using screened random phase approximation polarizability of isolated fullerenes demonstrates the key role of inner layers in electrostatic response of carbon nanostructures.

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Electromagnetic properties of thermoplastic polymer composites containing carbon nanoparticles in frequency range 10 MHz - 1.5 Thz

V. Suslyaev, V. Zhuravlev, E. Korovin, K. Dorozkin, I. Mazov, S. Moseenkov, V. Kuznetsov, A. Romanenko
National Research Tomsk State University, Russia;
Boreskov Institute of Catalysis, Russia;
Nikolaev Institute of Inorganic Chemistry, Russia;
National Research Novosibirsk State University, Russia

Design of carbon-loaded composited with tailorable electromagnetic properties is of crucial importance in the field of aviation and space research, novel electronics, etc. Carbon nanoparticles (CN), such as multiwall carbon nanotubes (MWNTs) and onion-like carbon (OLC) are promising material due to their lightness and superior mechanical, electrical and optic properties. Incorporation of CN in polymer matrix leads to significant improvement properties of composites – mechanical strength, electrical conductivity, fracture toughness, electromagnetic shielding properties, non-linear optic properties. Development of light-weight EM-active composites would allow to solve certain problems of electromagnetic compatibility and shielding of electronic devices. We present the results of research structural and electromagnetic properties of thermoplastic polymer composites filled CN with different structure, mean diameter, morphology and surface chemistry. Polymethylmethacrylate, polystyrene, polyethylene and polypropylene were chosen as matrices. Investigation of various composites with different physical-chemical properties (structure, surface tension, etc.) allows revealing significant differences in properties of composites containing same filler and produced by similar way. Electromagnetic properties of nanocarbon-loaded composites were investigated in ultra-wide range of frequencies (10 MHz-1.5 THz). Main regularities of electromagnetic response properties of composites depending on their structure, matrix and filler type and morphology were obtained. Investigated materials show high interaction with electromagnetic radiation depending on their structural and morphological properties allowing development of tailorable materials for wide variety of applications.

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