Nanocomposites and nanomaterials
Raman study of CeO_x on graphene nanoparticles for catalytic applications

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Cerium oxide due to its strong catalytic activity is considered as a highly effective alternative of noble metal catalysts. The catalytic activity of ceria oxide can be further enhanced in the nanostructures or composites due to the nanoscale effects. We report on micro-Raman study of CeO_x over graphene nanoparticles supported catalyst synthesized in search for a new effective catalyst for the transformation of oxygenates. Raman spectra were measured at excitation of 488 nm and varied laser power from 0.1 to 10 mW. Raman spectra of pure constituents at the lowest laser power were found to be typical for ceria with F_{2g} vibrational mode at 465 cm^{-1}, and for graphene nanoparticles with prominent D, G, and 2D features at 1359, 1586 and 2714 cm^{-1}, while spectrum of the CeO_x-graphene composite revealed only the phonon modes of the graphene. However, appearance and increase in the relative intensity of the composite's CeO_x band was registered at laser powers higher than 5 mW, whereas its frequency position was found to be shifted down to 450 cm^{-1}, as compared to 463 cm^{-1} for pure CeO_x at the same laser power. An effect could be related to a chemical reduction of CeO_x on graphene surface under laser radiation, which could be connected with laser-induced charge transfer between CeO_x and graphene. This assumption is confirmed by drastically modification of the graphene spectrum in the CeO_x-graphene system, namely by increase in D/G intensity ratio due to increase of defects in the site of CeO_x interaction with graphene, and by decrease of electron-phonon interaction, estimated from the high-frequency shift of the 2D mode from 2697 to 2709 cm^{-1}. Demonstrated process of laser-induced modification of CeO_x-graphene composite has further prospects for application in the industrial technology. This work was supported by project STCU №6175 and Ukrainian-Polish joint research project.