Comparative study of reflectance properties of nanodiamonds, onion-like carbon and multiwalled carbon nanotubes

Moseenkov S.I.[1,3]*, Kuznetsov V.L.[1,3], Elumeeva K.V.[1,3], Larina T.V.[1], Anufrienko V.F.[1], Romanenko A.I.[2,3], Anikeeva O.B.[2,3]

[1]Boreskov Institute of catalysis, 630090, Novosibirsk, Russia
[2]Nikolaev Institute of Inorganic Chemistry, 630090, Novosibirsk, Russia
[3]Novosibirsk State University, 630090, Novosibirsk, Russia
**e-mail: moseenkov@catalysis.ru*

Carbon nanomaterials are promising candidates for potential broadband limiting applications and extremely low reflectance coatings, particularly in the infrared, visible and UV spectral regions. In this paper we have performed comparative study of diffuse reflectance of nanodiamond (ND), sp^2/sp^3 composites and onion-like carbon (OLC) and multiwalled carbon nanotubes (MWNTs) in visible and UV regions.

ND, sp^2/sp^3 composites and onion-like carbon (OLC) produced via high temperature annealing of the same set of NDs allow us to vary sp^2/sp^3 carbon ration, size of primary particle agglomerates and concentration of defects while MWNT set provides possibility to vary NT diameters and length, order/disorder degree (via high temperature MWNTs annealing).

The diffuse reflectance of carbon nanomaterials depends mainly on electronic configuration, defect concentration, size of graphene-like ordered fragments and agglomerates in nanocarbons along with their morphology. Thus the increase of nanographene shells size in the interval of 1-200 nm on ND particle (produced after elimination of surface functional groups) results in the increase of the absorbance accompanied with red shift (because of the π band's optical transition). The increase of number and size of fullerene-like shells demonstrates significant increase of absorbance (decrease of reflectance) which correlates with increase of density states at the Fermi level calculated from temperature dependence of conductivity of NDs annealed at different temperatures.

Thin MWNTs (d~10 nm) demonstrate higher absorbance than that of thick MWNTs (~20 nm). This phenomenon may be described taking into account significant difference between numbers of individual nanotubes of each type incorporated in the same volume of sample surface layers while conductivity of thinner MWNTs is lower than that of thick NTs.

Decrease of defect number in nanocarbon materials, annealed at temperature higher then Debye temperature results in the increase EMI reflectance.