Infrared absorption studies of surface functional groups of chemically modified nanodiamonds

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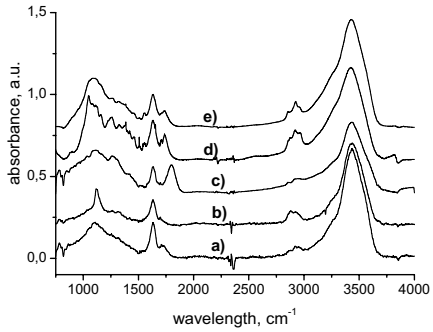
Efficient chemical modification of detonation nanodiamond (DND) surface are able to occur in suspension consist of separate DND particles. Production such suspension require either disaggregate solute (breaking bonds between particles) and prevent particles coagulation that happens when particles have certain charge due dissociation of surface functional groups.

"Z+" and "Z-" samples annealed at 400°C in hydrogen atmosphere and in air respectively. Surface of other samples are decorated with separate metallic ions Cu^{2+}, Co^{2+}, Ce^{3+}, Ce^{4+} or Eu^{3+} alternatively. Concentration of ions varies between 0.1 wt.% and 2.5 wt.%. All the samples compared with initial purified DND and with each other.

Obtained spectra reveal that "Z+" sample surface contain no carbonyl groups, but a lot of C-H groups, instead. Opposite, "Z-" sample has a lot of carbonyl groups in place of C-H groups. Apparently, ultrasonic treatment in water solution leads, that all samples contain significant and nearly equal amount of hydroxyl groups.

The metallic ions modified samples did not show any significant difference of its' surface visible at IR spectra. Furthermore, it is impossible to distinguish samples with different concentrations of the ions. The only one sample (modified with Cu^{2+}) showed visible difference, but this sample had been prepared from different kind of initial DND then others were.

Altogether, the only one functional group (except hydroxyl) predominate at the surfaces of each "Z+" and "Z-" samples, causing their high disperse ability in water solution. Analyzing IR spectra, neither concentration nor type metallic ions at DND particles surface can be established but certain information about initial DND and methods of purifying and modification applied to the sample can be obtained.



DND spectra of a) initial purified DND b) Z+ c) Z− d) Cu^{2+} modified DND e) Co^{2+} modified DND.