Ag nanoparticles induce stress reactions in higher plants

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Silver nanoparticles (Ag NPs) are the world's most widely used nanomaterial that has a number of applications in nanophotonics. Despite their positive aspects, Ag NPs accumulate in the soil and have become an important environmental contaminant. Some data show that Ag NPs inhibit growth of higher plants which are the most prevalent form of life on the Earth. Here, we have explored cellular mechanisms of Ag-NP-induced phytotocixity using model plant Arabidopsis thaliana. We have found that manufactured Ag NPs (40 nm; 0.05-10 g l 1) can decrease the rate of root elongation and leaf expansion and activate key plant stress reactions, such as transient Ca2+ elevation and production of reactive oxygen species (ROS). Ag NPs also inhibited photosynthetic efficiency, and their presence in media led to accumulation of very high Ag levels in plants. NPs had much more pronounced effect than bulk. Using electron paramagnetic resonance spectroscopy, we have demonstrated that Ag NPs probably interact with L-ascorbic acid promoting ROS imbalance. Overall, out data have shown for the first time that Ag NPs induce stress reactions in plant cells and shed the light on potential environmental issues arising from the use of metal nanoparticles.

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Comparative analysis of the effect of enhancement of IR signals of biomolecules adsorbed on single wall carbon nanotubes and graphene nano plates

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It is known an effect of surface enhanced infrared absorption (SEIRA) of molecules near rough metal surface by a factor 10-200. However, this effect could be registered for molecules adsorbed on non-metallic surface, namely carbon surfaces, semiconductors, etc. The aim of the present report is comparative analysis the effect of enhancement of thymine adsorbed on single wall carbon nanotubes (SWCNT) and graphene nano plates and single layer graphene oxide. We studied thymine (Sigma-Aldrich), SWCNT (Moscow Institute of Physics), graphene nano plates and single layer graphene oxide (USA). The samples of thymine and thymine/graphene and thymine/oxide graphene complexes were prepared. All samples were mixed by ultrasonic mixer for 30 min. FTIR spectra have been registered with IFS-66 Bruker instrument in the 400–5000 cm-1 region. We got enhancement factor of about 2-6 for thymine adsorbed on SWCNT. The spectra of thymine/SWCNT shows that maximum factor of enhancement equalled to 6 for bands, which is corresponding to the C-H, C-OH and C-N. The maximum enhancement factors for thymine absorbed on the graphene plate and graphene oxide are 2 and 5 for band 1754 cm-1 (C2=O vibrations). Thus, we can assumed that the factor of enhancement of thymine adsorbed on the graphene plates is less than enhancement factor of thymine adsorbed on the SWCNT. Mechanism of enhancement of thymine molecules adsorbed on nanostructured carbon substrates, seems to have chemical and electromagnetic nature. The last mechanism could be connected with excitation of plasmon vibrations in carbon layers in IR region and discussed here. We thank for financial assistance Project STCU 5525 (2012-2013), Ukrainian- German project № M366 (2011-2012), Russian-Ukrainian Project (2012-2013).

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