Nanocomposites and nanomaterials

Nanowires based on plant viruses and metal nanoparticles

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A plant virus, especially the tobacco mosaic virus (TMV) is considered to be the most potential candidate for using as building blocks of nanobiostructures. The genetic programmability of the TMV membrane allows producing TMV derivatives with high selectivity to inorganic materials or surfaces of substrates. The latter fact allows to obtain effective self-assembly of nanoscale biostructures in functional compact devices.

We investigated the behavior of plant viruses, including TMV and LMV (lucerne mosaic virus) on various metal surfaces – silicon, gold, silver, copper. The main causes of virion adsorption on metal and semiconductor surfaces were established.

The technology of synthesis of *hybrid virus inorganic complexes* TMV-Au is based on a cyclic deposition of gold nanoparticles on TMV through five cycles of gold recovery by successive addition of HAuCl4 and NaBH4. Dividing the process into cycles allows avoiding bioinductive gold recovery on the virion surface (before adding the reducing agent) and forming particles of different sizes.

The morphology and mechanisms of producing nanowires based on TMV-nanoparticle of gold were investigated by using probe microscopy methods with atomic resolution. It was shown that the interaction of the plant viruses with antibodies led to a lack of aggregation and clustering of nanoparticles. Chemical breakdown of the gold surface after removing the TMV virus nanoparticles from it was shown.

The optical properties of nanocomplexes *based on* TMV-gold nanoparticles were investigated and the optical activity of TMV -Au complex with a peak at 540 nm was established. There is the dependence of the intensity of optical absorption spectra on the orientation of the polarization vector. The availability of circular dichroism opens the possibility of using TMV-Au complexes to create metamaterials.

Probe spectroscopy methods revealed that in the range of 0 to 6 volts there were spontaneous and induced transitions into the state with relatively high electrical conductivity, which can be used for manufacturing digital recording devices with high-density information.