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Method for production of high-viscosity suspensions (gels) using encapsulated metal nanopowders

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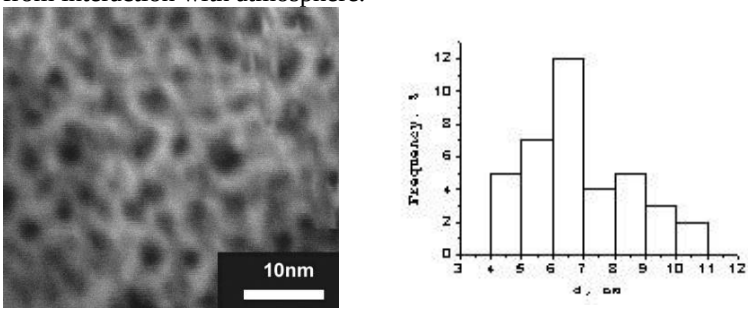
It is well-known fact that colloidal solutions based on metal nanopowders find application as initial substance for production of mineral fertilizer, drugs for curing of fungus disease of animals and plants, phytophagans, BAD for food industry, fillers to lubricants of coloring and magnetic pigments etc. Producing of stable suspension with set size and concentration of the metal nanoparticles is necessary condition for their practical application.

Aim of the present work is producing of stable high-viscosity suspension (gel) based on bio-compatible substances using metal nanoparticles, encapsulated into salt matrix (NaCl), as a precursor.

Metal biogenic nanopowders were produced by mutual phase-vapor deposition of metal and alkali metal halide [1]. Encapsulation of the metallic particles in chemically inert matrix, on the one had, limits their size, and, on the other hand, provides for formation on their surface of protective cover (Figure 1). This prevents particle consolidation processes in their storage as well as protects them from interaction with atmosphere.



а) в)

Fig. 1. а - Characteristic electron microscopy image (light field) of a condensate formed at simultaneous deposition of vapour flows of particle and sodium chloride, в - size distribution of nanoparticles

Such a composite structure allows long-term storage of the encapsulated nanoparticles in simple atmosphere, and, then, after dissolving of the salt cover, using them for suspension production [2]. Method of dispersion of these powders in PEG compositions (4-7 parts of PEG 1500-800 in volume and 3-6 parts of PEG 400-600 in volume).

The initial powder, put into liquid, was subjected to dispersion during 60 min, accompanied by heating to 60-80°C with subsequent rapid cooling to room temperature. Such an approach allows storage of produced gel during long period of time in compact form, and, then, producing the suspensions dissolving it by water. The properties of produced suspension were examined using Malvern Zetasizer Ver.6.20 device. Figures 2 and 3 show a particle distribution by size as well as zeta-potential of the suspension. It can be seen that application of the proposed method allows producing of the stable high-viscosity suspension (gel) based on biogenic metal particles of nanosized scale using metal nanopowders encapsulated in the salt matrix as a precursor.

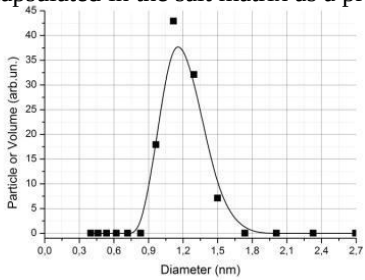


Fig. 2. Distribution of Al particles by dimensions in the suspension based on amines

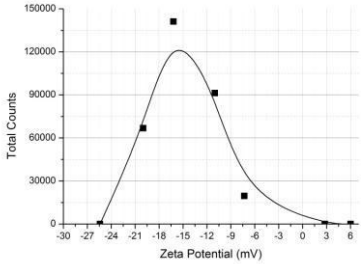


Fig. 3. Zeta-potential of Al particles

1. US 8491972B2 Method of producing encapsulated nanopowders and installation for its realization Ustinov A.I., Melnichenko T.V., Liapina K.V., Chaplyuk V.I., 2013

2. *K.V. Liapina , P.G. Dulnev, A.I. Marinin, T.V. Melnichenko , A.I. Ustinov* Properties of colloidal solutions obtained by using as a precursor metal nanoparticles encapsulated in the salt shell // Biotechnology.-2014.