

.....

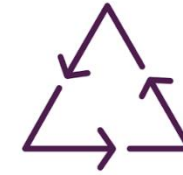
II International Conference on Advances in Materials Science and Technology - CAMSTech-II-2021»

.....

«Influence of the Polymer Nature on the Formation and Stability of Copper Nanoparticles»

G.Yu. Ostaeva, E.A. Eliseeva, I.Yu. Isaeva, I.V. Morenko, A.A. Litmanovich

This work was supported by the Ministry of Science and Higher Education of the Russian Federation within the framework of a basic part of the state assignment in the field of scientific research (project no. FSFM-2020-0010).

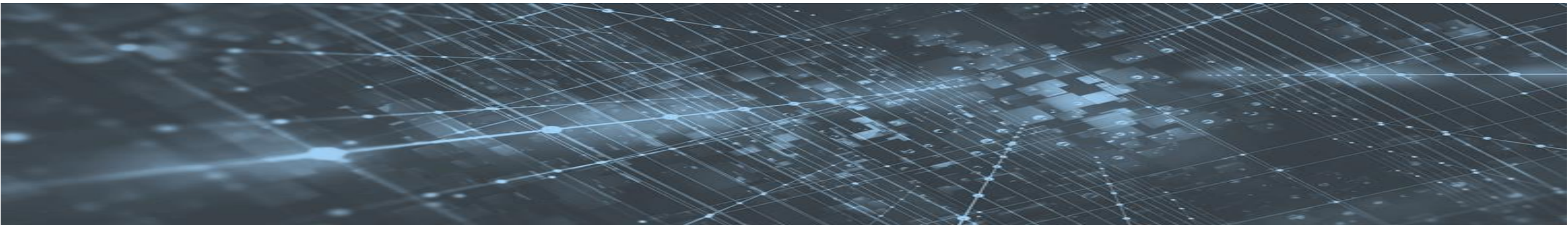


Problem statement

Obtaining nanoparticles with the specified properties and characteristics is one of the fundamental problems of modern nanoscience. This process is significantly influenced by the technology of nanoparticle synthesis. One of the approaches to obtaining nanoparticles is synthesis in the presence of polymers.

The effect of the nature of the polymer on the resulting nanoparticles is different.

In this paper, the influence of the polymer nature on the morphological characteristics of copper-containing nanoparticles, as well as on their stability, is investigated.

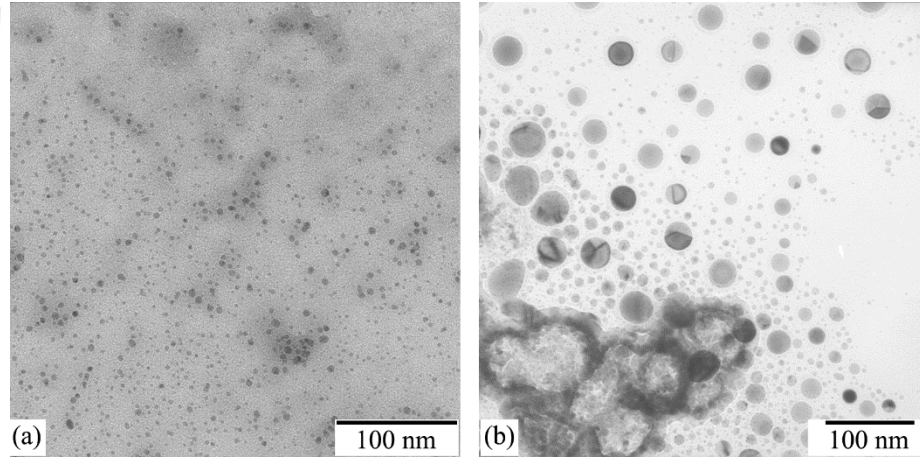


Solution methods

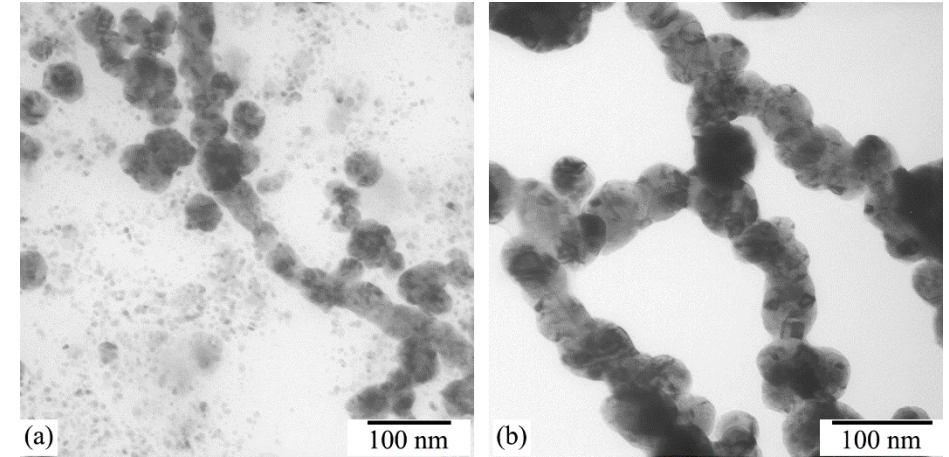
- Copper-containing nanoparticles were obtained by reducing copper ions from a solution of CuSO_4 using tert-butylamine borane.
- Polyethylene oxide, polyacrylic acid, PEG 6000 monostearate, PVP 6000 monostearate, N-benzyl-N,N-dimethyl-N-(methacryloyloxyethyl) ammonium chloride, poly-1,2-dimethyl-5-vinylpyridinium-methyl sulfate and poly-N-vinylpyrrolidone were used as polymer stabilizers.
- pH was controlled during the synthesis.
- The synthesis products were studied using transmission electron microscopy.



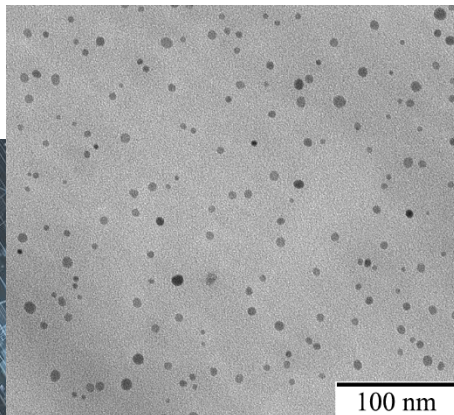
Results



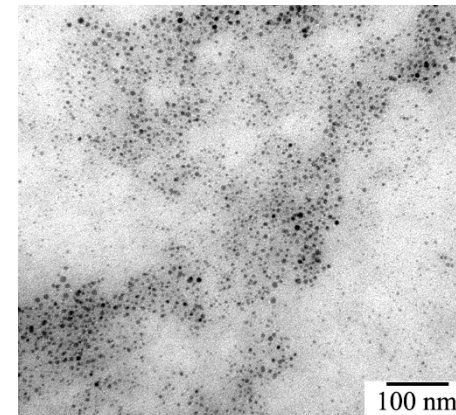
Copper sols obtained in the presence of N-benzyl-N,N-dimethyl-N-(methacryloyloxyethyl) ammonium chloride (a) and poly-1,2-dimethyl-5-vinylpyridinium-methyl sulfate (b).



Copper sols obtained in the presence of PEG 6000 monostearate (a) and PVP 6000 monostearate (b).

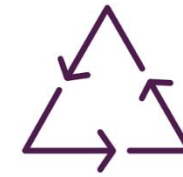


Copper sol obtained in an aqueous solution of PVP.



Copper sol obtained in an aqueous solution of polyacrylic acid.





Conclusions

This study shows that:

1. in the presence of polyethylene oxide, sediments are formed, but the particles are not oxidized
2. the smallest particles are formed in a solution of polyacrylic acid
3. the smallest particles are formed in a solution of polyacrylic acid, but the stability of these particles is the least
4. In the presence of PVP and polycations, sols with a particle size in the range from 3 to 12 nm are formed, whose stability to aggregation and oxidation is high.

It was found that macromolecules not only control the growth of particles during the formation of a new phase, but also ensure the stability of copper nanoparticles to oxidation in all studied systems (non-ionic polymers, polyelectrolytes, amphiphilic polymers) .

It is established that amphiphilic polymers of block structure are superior to conventional polymers in the ability to protect copper nanoparticles.

Contacts

Ostaeva G.Yu., Eliseeva E.A., Isaeva I.Yu., Morenko I.V., Litmanovich A.A.
Moscow Automobile and Road Construction State Technical University (MADI)
E-mail: galinaostaeva@mail.ru