

Effect of the structure of silica/polyacrylamide hybrids on cobalt nanoparticles formation

Your organization logo

Permyakova N.M.¹, Fomenko A.S.¹, Zheltonozhskaya T.B.¹, Klepko V.V.¹, Klymchuk D.O.²

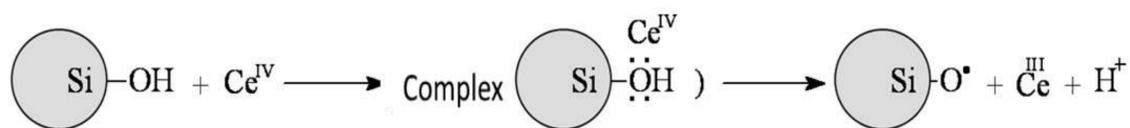
¹ Department of Polymer Physics, Institute of Macromolecular Chemistry of the NAS of Ukraine. 48 Kharkivske Shosse, Kyiv-02160, Ukraine. E-mail: permyakova@ukr.net

² M.G. Kholodny Institute of Botany of the NAS of Ukraine, 2 Tereshchenkivska St., 01601 Kyiv, Ukraine

Introduction

In recent years, cobalt nanoparticles (CoNPs) have attracted considerable attention due to their outstanding magnetic properties as ferromagnetic materials, which use in high-density magnetic storage media, gene deliver and as targeted drug carrier. This paper presents a simple and effective method for producing stable CoNPs in an aqueous medium using polymer/inorganic hybrid (PIH) based on silica nanoparticles and grafted polyacrylamide chains

Synthesis of PIH:

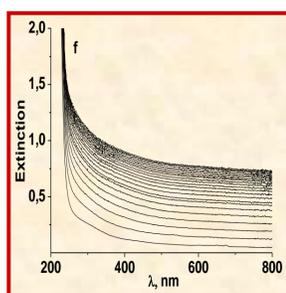
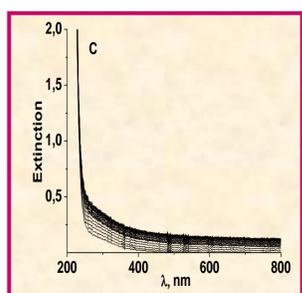


3 PIH samples with different number and length (molecular weight) of the grafted PAAm chains per inorganic particle was synthesized by a free-radical grafting polymerization of acrylamide (AAm) "from" the surface of silica hydrosol

Methods

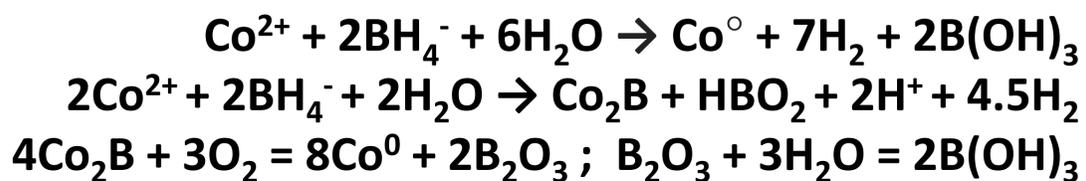
The processes of borohydride reduction of Co-salt to nanoparticles in pure water and aqueous solutions of PIH were studied depending on the concentration of PIH and metal salt (and reducing agent) using **photography, UV-visible spectroscopy, TEM and WAXS**. A special approach to characterizing the kinetics and efficiency of CoNPs formation in pure water and hybrid solutions using UV-Vis spectroscopy has been proposed and implemented.

UV-Vis spectra of the Co²⁺/PIH mixtures after NaBH₄ addition



CoNPs

Borohydride reduction of cobalt ions:

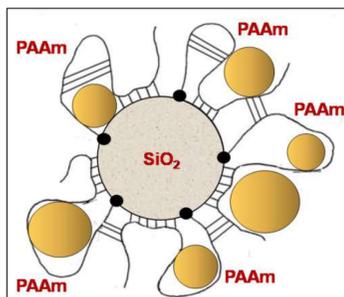
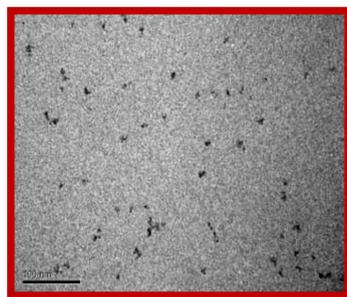
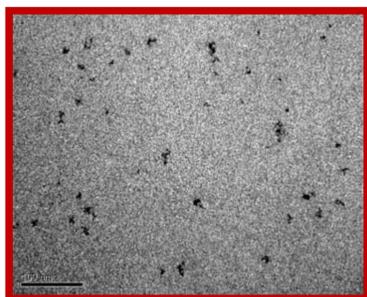


Conclusion

The kinetic parameters of the CoNPs formation process as well as the yield, size, and morphology of nanoparticles in hybrid solutions and pure water at various concentrations of metal salt and hybrid were determined. It was shown that the reduction process developed much slower in hybrid solutions compared to pure water.

It was revealed that among the PIH samples, the most intense process of CoNPs formation developed in hybrid matrices with a rather loose "corona" of grafted PAAm chains.

Morphology of CoNPs/ PIH compositions



The morphology of the CoNPs/PIH compositions is represented mainly by separate hybrid particles of ~9-35 nm containing metal nanoparticles with a size of ~1-7 nm.