USE OF BIOGENIC SULFIDE FOR THE SYNTHESIS OF CuS NANOCRYSTALS AND NANOCOMPOSITES.

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Abstract

During the metabolism of organic matter (CH_2O), sulfate-reducing bacteria (SRB) use sulfate as the terminal electron acceptor, resulting in the production of H_2S. This biologically generated sulfide, in the presence of metal ions, can be used for metal precipitation (Bhagat et al., 2004). The use of SRB in bioremediation processes, namely, in the reduction of high-content sulfate and metal effluents, is well documented (Costa and Duarte, 2005; Garcia et al., 2001). Nevertheless, the process generates an excess of sulfide and the elimination of the sulfide in excess and disposal of the metal sulfides produced are also problems that need to be carefully addressed. Copper monosulfide (CuS) has gained considerable attention in material science due to its excellent potential in catalysis (Mallick et al., 2007), optical functionality (Liz-Marzan, 2006) and electronic functionalities (Kamat, 2002). Moreover, copper monosulfide shows metallic conductivity and transforms into superconductor at 1.6 K, exhibiting fast-ion conduction at high temperature (Yang and Xiang, 2005). In this work, we aimed for the valorization of these bioremediation by-products and have successfully used the biogenic sulfide produced by SRB for the production of well defined CuS nanocrystals (covellite) with a mean size of ~3.5 nm. We also showed that the use of TiO_2 and SiO_2 as substrates resulted in the respective composite materials. Considering the growing interest of CuS nanoparticles in processes such as photocatalysis (Li et al., 2010; Stroyuk et al., 2004) and the simplicity of the process presented, this is a convenient route for the biological synthesis of functional materials with potential interest.

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