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Synthesis and Antimicrobial Efficacy of Magnetic Silica Microspheres Decorated with Ag Nanoparticles

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Abstract

Magnetic microspheres decorated with ligand-free metal nanoparticles could be a great colloidal hybrid material (CHM) as a recyclable catalyst or antimicrobial agent. Their surface is exposed directly to the medium containing target material and so, they can show an abnormal surface activity of nano-sized material toward the target while restraining from aggregation due to their hybridized overall micron-size effect. The microspheres can facilitate recycling of the materials by magnetic separation through an inclusion of magnetic material in them.

Here we present the magnetic silica microspheres decorated with ligand-free silver nanoparticles with ~10 and ~30 nm sizes and their applications as a catalyst and as an antimicrobial agent, respectively.

For the synthesis, aminopropyl-functionalized magnetic silica microspheres were mixed with gold and silver nano-seeds around 1~3 nm sizes and the nano-seeds bonded to the microsphere were grown to the larger nanoparticles so that the nanoparticles can embrace the aminopropyl pillars in their hybridized colloidal structure. The synthesized CHM was characterized by (HR)TEM, (HR)STEM, SEM, EDS, and ICP elemental analysis.

Catalytic application study using CHM with ~10 nm silver for the reduction of 4-nitrophenol to 4-amionophenol showed that the CHM catalyzed the reaction with the first order kinetics on the concentration of 4-nitrophenol and catalytic efficacy was the same within experimental error up to 5 cycles and expected to be further continued.

Antimicrobial activity was tested by using CHM with ~30 nm silver for *E.coli* CN13. The cell membrane of *E.coli* CN13 began to be destroyed as soon as the CHM was added and was totally ruptured at 30 minitues.