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Design of Nickel Ferrite@SiO_2@TiO_2 Core-Shell-Shell Magnetic Microparticles for Enhancement of Mass Transfer in a Fast Catalytic Reaction

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Magnetic microparticles (MMPs) are of great interest in the field of microfluidics. The use of micrometric magnetic particles offers the advantage of a large specific surface for chemical binding, in combination with a high mobility imposed by the long range magnetic forces acting on them. The movement of MMPs can be controlled by the intensity and orientation of an external magnetic field. To achieve the maximum enhancement in mass transfer rate, one should increase the velocity of particle movement in flow. The velocity of magnetic microparticles is usually limited by the poor magnetic properties of most of them. Here we show that the new generation of composite MMPs based on nickel ferrite nanoparticles of controlled size and composition leads to exceptional magnetic properties. Silica and titania functionalized MMPs composites were synthesized and used as a microactuator as well as a support for heterogeneous catalysts. The magnetic actuation of composite catalysts considerably enhances mass transfer in a reactor. The separation of the composite catalyst from the reaction mixture also becomes facile. The high mass-transfer rate in combination with excellent catalytic properties and high stability in organic solvents opens up new promising avenues in the corresponding fields.