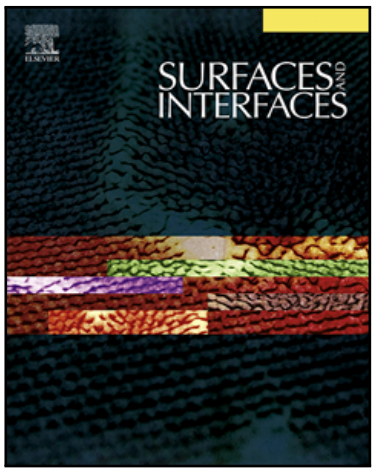


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# $H_2$ generation from $NaBH_4$ methanolysis via magnetic field sensitive ionic liquid coated silica particles as catalyst

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## ABSTRACT

Upon the preparation of Magnetic ($Fe_3O_4$) nanoparticles (NPs), they were coated with amino-functionalized silica ($SiO_2@NH_2$) via the modified Stöber method. $SiO_2$ coated $Fe_3O_4$ ($Fe_3O_4@SiO_2$) particles and $SiO_2@NH_2$ coated $Fe_3O_4$ ($Fe_3O_4@SiO_2@NH_2$) particles were turned into ionic liquid (IL) colloids as $Fe_3O_4@SiO_2@NH_3^+Cl^-$, $Fe_3O_4@SiO_2@NH_3^+NO_3^-$ and $Fe_3O_4@SiO_2@NH_3^+HSO_4^-$ by the treatment of $Fe_3O_4@SiO_2@NH_2$ with hydrochloric acid (HCl), nitric acid ($HNO_3$) and sulfuric acid ($H_2SO_4$), respectively. The size of the prepared silica-based particles was approximately 500 nm by SEM images, and the zeta potential values varying between -59 and +26 mV. The catalytic activity performances of these silica-based particles as catalysts were investigated for $H_2$ generation from methanolysis of $NaBH_4$ in terms of the types of particles, reusability, recyclability, the concentration of $NaBH_4$, and the reaction temperature. Amongst the prepared IL colloids, $Fe_3O_4@SiO_2@NH_3^+Cl^-$ particles were found to be the most effective catalysts for the methanolysis reaction of $NaBH_4$. The maximum Hydrogen Generation Rate (HGR) value of 13188 ± 196 mL $H_2$ $g^{-1}$ $min^{-1}$ was attained at 500 mM $NaBH_4$ by using 50 mg $Fe_3O_4@SiO_2@NH_3^+Cl^-$ as catalyst at 25 °C. Additionally, turn over frequency (TOF) value was calculated as 43.1 ± 3.1 $H_2$ mol (mol of N.min)$^{-1}$ for $Fe_3O_4@SiO_2@NH_3^+Cl^-$ under the same reaction conditions. Moreover, activation energy (Ea) values for the methanolysis of $NaBH_4$ using $Fe_3O_4@SiO_2@NH_3^+Cl^-$ particles as catalyst were found as 32.5 ± 0.5, 39.9 ± 0.3 and 24.4 ± 0.7 kJ $mol^{-1}$ in the temperature range of -15–45, -30–0 and 15–45 °C, respectively, that are