

Synthesis of Nano-silica

Nano Silica was prepared according to the methodology described by Premaratne et al. (2013). Briefly, Rice husk (RH) was washed by deionized water and oven dried at 105 °C to remove the moisture. Then, the dried RH was calcinated at 700 °C for 6 hours to produce silica. Ten grams (10 g) calcinated RH was stirred in 80 mL of 3.0 M NaOH solution and the mixture was boiled for 3 hours. The solution was filtered and the residue was washed with 20 mL deionized water. The filtrate was allowed to cool down to room temperature and 2.5 M H₂SO₄ acid was added until the pH of the solution becomes pH 2 and followed by NH₄OH until pH 8.5 at room temperature. The filtrate was then dried at 120 °C for 12 hours. The resulted sample was powdered and pure silica sample was extracted by refluxing with 6 M HCl for 4 hours. Then the silica sample was washed repeatedly with deionized water until the solution become acid free. Precipitate was separated by centrifugation. The purified silica sample was dried at 105 °C for 2 hours. Pure silica sample extracted from RH was then dissolved in 3.0 M NaOH by continuous stirring for 10 hours on a magnetic stirrer. Then 0.5 M H₂SO₄ was added drop-wise to adjust pH in the range of 7.5-8.5. The precipitated silica was washed repeatedly with warm deionized water until the filtrate became alkali free. Precipitate was separated by centrifugation (3500 rpm for 1 hour). The resulted sample was dried at 50 °C for 48 hours in order to obtain nano-silica.

Synthesis of magnetic nanoparticles.

Magnetic nanoparticles (MNPs) was prepared according to Jeon et al. (2009). Briefly, 6.1 g FeCl₃.6H₂O and 4.2 g FeSO₄.7H₂O were mixed and dissolved in 100mL using ultra sonication. Thereafter, a total of 25mL 6.5M NaOH was then slowly added and mixed with the above solution. The solution was mixed for an hour after the addition of NaOH was completed. The black precipitates obtained were washed with ultrapure water several times with the assistance of an external magnetic field. This procedure leads to the formation of αFe₃O₄ nanoparticles with a size of around 10–20 nm. The αFe₃O₄ was then oxidized in air at 300°C for 3 h to obtain γFe₂O₃.

Synthesis of Nano-Cu

Nano-Cu was prepared by chemical precipitation according to the procedure described by Chen and Lim (2002). Briefly, CuSO_4 was dissolved in deionized water (0.01M). Then, 0.02 M Ascorbic acid was added and stirred under magnetic stirrer. Thereafter, 25 ml of sodium borohydride (NaBH_4 , 0.1M) was drop wise into the solution of CuSO_4 under stirring. The precipitated Nano-Cu was washed repeatedly with warm deionized water until the filtrate became alkali free. Precipitate was separated by centrifugation (3500 rpm for 1 hour). The resulted sample was dried at 50 °C for 48 hours in order to obtain nano-Cu.

Characterization of synthesized materials.

The surface morphology of the synthesized materials were investigated by A transmission electron microscope (TEM) (H600 Electron Microscope, Japan).

Results and Discussion

Characterization of Synthesized nanomaterials.

The Nano- SiO_2 , Nano-CuO and Nano magnetic ($\gamma\text{Fe}_2\text{O}_3$) were characterized by SEM (Fig. 1a, b and c). Fig. (1a) shows that the pure SiO_2 Nano-particles were uniform, loose and without reunion, and its grain size ranges from 5nm to 100nm. The nano-silica particles do not show clear boundaries as they are in agglomerate and amorphous form. SEM images demonstrated that the as-prepared copper oxide nanoparticle (fig. 1c) are cubic in shape.

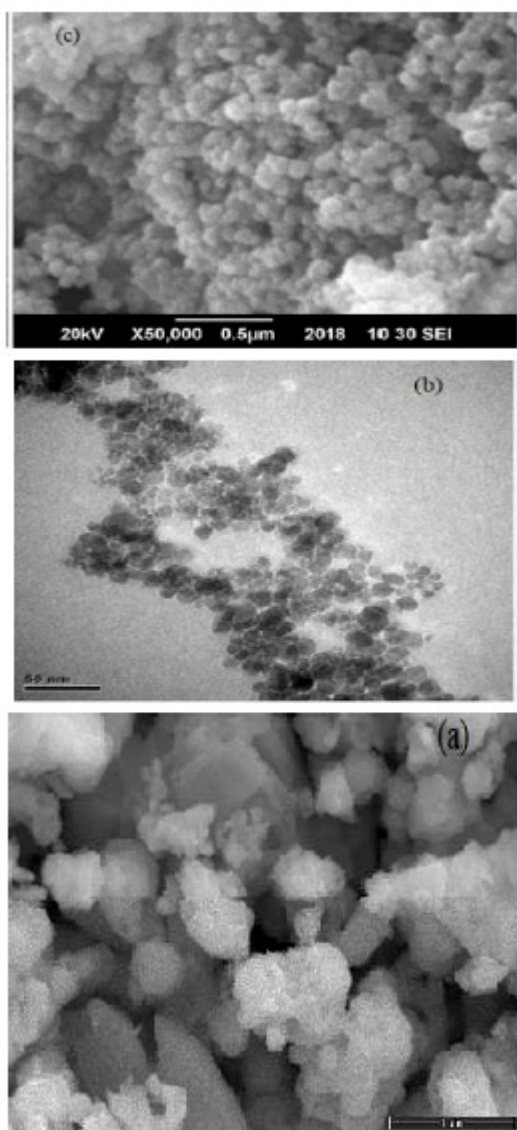


Figure S1. SEM images of Nano-SiO₂ (a), Nano- γ Fe₂O₃ (b) and Nano- Copper (c).

References

49. Jeon, C.S., Baek, K., Park, J.K., Oh, Y.K. and Lee, S.D. 2009. Adsorption characteristics of As (V) on iron-coated zeolite, *J. Hazard. Mater.* 163, pp. 804–808.
50. Chen, J. P.; Lim, L. L. 2002. Key Factors in Chemical Reduction by Hydrazine for Recovery of Precious Metals. *Chemosphere*. 49, 363–370.
51. Khan, A., Rashid, A., Younas, R., Chong, R. 2016. A chemical reduction approach to the synthesis of copper nanoparticles. *Int Nano Lett.* 6:21–26. DOI 10.1007/s40089-015-0163-6