

Facile and green preparation of magnetite/zeolite nanocomposites for energy application in a single-step procedure

ABSTRACT

This paper presents a green, facile and rapid method to prepare magnetite/zeolite-nanocomposites (NCs) in one step procedure at ambient temperature. The powder X-ray diffraction (PXRD) pattern of iron oxide nanoparticles (NPs) with the sole zeolite showed the broadening of zeolite peaks attributed to the incorporation of Fe₃O₄. Field-emission scanning electron microscopy (FESEM) analysis depicted that the Fe₃O₄-NPs were formed on the surface of porous zeolite framework. Transmission electron microscopy (TEM) analysis displayed the Fe₃O₄ nanoparticles (NPs) were mostly in spherical shape with a mean diameter and standard deviation of 2.40 ± 0.41 nm. The selected-area electron diffraction (SAED) pattern confirmed the presence of cubic Fe₃O₄ phase. The vibrating sample magnetometer (VSM) results indicated the as-synthesized sample has a saturation magnetization of around 6.52 emu g⁻¹. The magnetite/zeolite-NCs can be considered as a low-cost alternative catalyst for oxygen reduction reaction (ORR) process. The electrochemical measurement showed that the performance of magnetite/zeolite-NCs towards the ORR increased as the scan rate increased from 20 mV s⁻¹ to 500 mV s⁻¹. The ORR is a diffusion-controlled process in the alkaline medium.

Keyword: Green synthesis; Fe₃O₄ nanoparticles; Zeolite; Nanocomposites; Oxygen reduction reaction