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