Post-functionalization of polymeric mesoporous C@Zn core–shell spheres used for methyl ester production

ABSTRACT

In the present study, the mesoporous carbon@zinc (C@Zn) core-shell spheres were hydrothermally synthesized, using polyethylene glycol (PEG) as the surfactant and d-glucose as the pore forming agent. Then, the post-sulfonation treatment was carried out to prepare polymeric mesoporous SO_3H-ZnO catalyst. The physicochemical, structural, textural and morphological properties of the synthesized catalysts were characterized by X-ray powder diffraction (XRPD), surface area analysis (Brunauer–Emmett–Teller equation), temperature programed desorption (TPD), field emission scanning electron microscopy (FE-SEM), and transmission electron microscopy (TEM). The polymeric mesoporous SO_3H-ZnO catalyst owned a high surface area of 396.56 m^2/g with the average pore size of 3.45 nm and acid strength of 1.92 ± 0.05 mmol/g. The catalytic activity of the synthesized catalyst was further studied via esterification of the palm fatty acid distillate (PFAD), using a microwave-assisted technique. The biodiesel yield of 91.20% was achieved under the optimized esterification conditions as follows: the methanol to PFAD molar ratio of 9:1, catalyst concentration of 1.5 wt%, reaction temperature of 90 °C and reaction time of 15 min. The spent mesoporous catalyst was highly stable for reuse with nine continuous runs without further treatment.

Keyword: Mesoporous catalyst; Hydrothermal method; Surface modification; Post-sulfonation treatment; Esterification; Microwave-assisted technique