Superparamagnetic γ-Fe2O3 as Green Catalyst for PET Glycolysis

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This work presents the use of superparamagnetic γ-Fe2O3 for the chemical recycling of poly(ethylene terephthalate) (PET) through glycolysis. By exploiting its superparamagnetic nature, the easy separation of the γ-Fe2O3 catalyst from the reaction products, while ensuring dispersion during reaction, was facilitated. This gives the γ-Fe2O3 catalyst a great advantage over other previously studied metal oxide nanocatalysts. The material was synthesized from Fe3O4 nanoparticles, which was synthesized by co-precipitation method. The produced γ-Fe2O3 was characterized with TEM, XRD, XPS, TGA, VSM, and TPD-NH3. The particles had very small size of less than 10 nm, and very high surface area, reaching 147 m2/g. The VSM analysis confirmed that the fabricated material was superparamagnetic. Glycolysis reactions were carried out in a 10-ml batch type reactor at 300 °C. The catalyst was recovered after the reaction via magnetic decantation. The maximum BHET monomer yield from the catalyzed reaction reached 90 %. The catalyst was reused ten times, delivering almost the same BHET yield each time. Thus, superparamagnetic γ-Fe2O3 is a promising catalyst for PET glycolysis in terms of efficiency, recovery, and reusability.