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Tuning porosity in poly(ethylene glycol) methacrylate-based crosslinked copolymer resins for enhanced catalytic activity in aldol reactions

Aim

Investigation of porosity effect on the catalytic activity of crosslinked copolymer resins catalysts in aldol reactions.

Synthesis and characterization of crosslinked copolymers including poly(ethylene glycol) methacrylate and poly(ethylene glycol) dimethacrylate with different porosities, followed by functionalization with amine groups and evaluation of their catalytic activity in the aldol condensation of 4-nitrobenzaldehyde with acetone in various solvents.

Justification

Aldol reaction is one of the most important synthetic methods aimed at the formation of carbon–carbon bonds. This reaction is widely used to synthesize many compounds in various areas such as agriculture and chemicals, flavours and fragrances and pharmaceutical industry. At present, this reaction is carried out in the presence of homogeneous (i.e., mineral acid or base) or heterogeneous catalysts. However, most researchers have a vested interest in using heterogeneous catalysts due to their simple separation from the reaction mixture, reusability and environmentally friendly nature. Therefore, various heterogeneous catalysts such as mixed oxides, zeolites, aminated resins and mesoporous silica have been tested for this valuable reaction. Among them, amine functionalized poly(ethylene glycol) methacrylate-based resins have received special attention due to their unique properties including availability of the internal surface area for reactants, sufficient tolerance against degradation reactions and fast recyclability. However, the structure of these resins can be improved to increase their catalytic activity in various solvents. Since the optimized pore structures facilitate efficient mass transfer, reducing diffusion limitations and enhancing catalytic performance, it seems that tuning their porosity can be a promising strategy to produce an efficient catalyst for aldol reaction (Figure 1).



Figure 1. Schematic overview of the process.

Program

Various crosslinked co-polymers including poly(ethylene glycol) methacrylate and poly(ethylene glycol) dimethacrylate by varying the amount and composition of the inert component, amount of crosslinking agent and the stirring speed will be synthesized and used to produce a series of heterogenous basic catalysts. These catalysts will then be used in the model aldol reaction of 4-nitrobenzaldehyde with acetone and their catalytic activity will be evaluated in various solvents.

