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Continuous hierarchically structured multichannel microreactors – engineering and performance

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Siliceous monoliths with very open hierarchical pore structure of interconnected meandering flow-through macropores (20-50 μm) and large mesopores (10-25 nm) demonstrate huge potential as exceedingly effective multichannel catalytic microreactors operating at low backpressures at considerable flowrates.[1-6] Their large and easily accessible surface (300 m^2/g) can be covered with various functional groups,[2,3] metals[4] and enzymes[1,5,6] to obtain most attractive surface and catalytic properties (e.g. enzyme hyperactivity) and hence rapid rates of reactions and excellent selectivity.[1,5,6] We have studied their performance to demonstrate full technological viability using various immobilized enzymes: invertase (sucrose hydrolysis)[1], trypsin (proteolysis)[5] acyltransferase (transesterification of NPG)[6], and well as acid sulphonic groups catalysed synthesis of n-buthyl acetate and lactate[2,3], and application of isolated zirconium in chemoselective MRV reduction.[4] One striking example - full transesterification of neopentylglycol (NPG) with ethyl acetate in a biphasic system was observed in less than one minute (Fig. 1) compared to 7 hours using a native enzyme in batch system.[6] The microreactors appear to be stable in the continuous processes with aqueous or organic solvents even for several weeks.

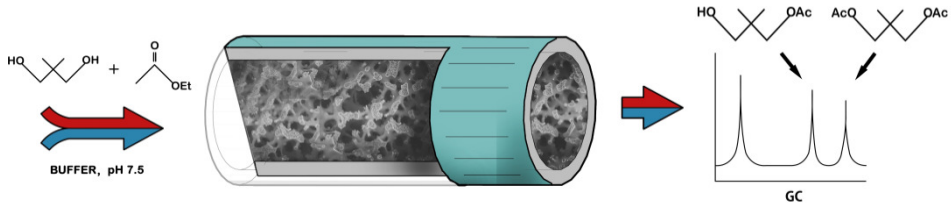

Figure 1.

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