Highly Efficient Oxidation and Reduction Using Continuous Flow Systems

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Continuous flow systems have many advantages; in particular when the size of pipe diameter is reduced specific effects arise due to the high specific interfacial area per unit volume. Recently, microchannel reactors with i.e. those with micrometer width and depth, have also been applied in the field of synthetic chemistry. Such reactors offer reaction environments with large interfacial area between different phases, and thus efficiently promote liquid-liquid, gas-liquid, and gas-liquid-solid reactions. Besides, they allow precise control of reaction variables, and assure increased safety in conducting chemical reactions. We have recently developed a palladium-immobilized microfluidic device to perform triphase hydrogenation reactions and found that substrates were converted to desired products quantitatively within two minutes. Moreover, we have also reported hydrogenation reactions using supercritical carbon dioxide ($scCO_2$) as a solvent and utilized capillary column reactors to increase productivity. Furthermore, a novel gold-immobilized capillary column reactor has been developed for the oxidation of alcohols with molecular oxygen. Various alcohols were oxidized to afford the corresponding carbonyl compounds in good to excellent yields. The gold-immobilized capillary column could be used for at least four days without loss of activity. Other continuous flow systems will also be discussed.