Advanced Catalyst Design by Aerosol Processing

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The technical features of aerosol processes make them highly interesting for the continuous, large scale, and tailored production of divided nanomaterials, and in particular of heterogeneous catalysts.[1] In addition to the “simple” aggregation of preformed particles via spray drying, advanced reactive aerosol processes – such as the “aerosol-assisted sol-gel” process (AASG) – allow synthesizing tailored-made catalysts with tunable surface properties, textures, compositions, etc.[2] The method is based on the sol-gel chemistry process, often coupled with the evaporation-induced self-assembly (EISA) concept. It allows producing micronic or submicronic, inorganic or hybrid organic-inorganic particles bearing tuneable and calibrated porous structures at different scales.

Here, we present an overview of different types of aerosol-processed heterogeneous catalysts and we explain why this peculiar mode of preparation has allowed reaching enhanced performance in various applications including olefin metathesis,[3] ethyl lactate synthesis,[4] olefin epoxidation,[5] (trans)-esterification.[6] We will also demonstrate the concept of bi-functional hybrid catalyst, combining a nano-zeolite and an enzyme to run a chemo-enzymatic cascade reaction.[7] Our objective is to demonstrate the tremendous possibilities offered by the coupling between bottom up synthesis routes and these aerosol processing technologies which will arguably represent a major route of innovation in the mushrooming field of catalyst preparation research.

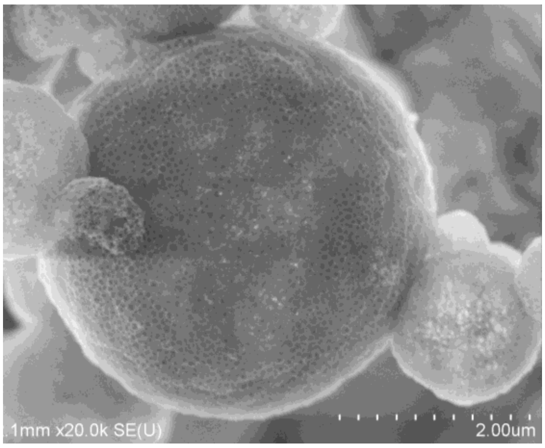

Fig.1 TEM micrograph of a hierarchically porous Ti-SiO_2 catalyst particle prepared by the aerosol-assisted sol-gel process and exploited in olefin epoxidation.[5]

Key words: sol-gel, spray drying, hierarchically porous, biocatalysis, hybrid catalysts

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