Highly Selective Partial Oxidation Reactions on Size-Selected Nanocatalysts: Towards the Understanding of Size/Shape & Function Relationship in Catalysis

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The focus of this presentation is on achieving high catalytic activity and selectivity in oxidative reactions by using highly monodisperse sub-nm size atomic metal clusters and few nm size particles. The applied techniques allow for ultimate control of both: surface composition, as well as catalytic particle size and composition – prerequisites in producing highly uniform active sites on technologically relevant supports for basic catalysis studies[1].

The catalytic systems were synthesized by production of sub-nanometer size-selected nanocatalysts in a laser ablation cluster source[2] and few nm large nanoparticles in an arc cluster ion source (ACIS)[3] and their subsequent deposition on a chemically uniform thin alumina film prepared by atomic layer deposition technique on naturally oxidized silicon wafer[4].

Epoxidation of Propylene. The samples of size-selected silver nanocatalysts were first imaged with scanning electron microscopy (SEM) for uniformity (see Fig.1) and their catalytic properties studied in partial oxidation of propylene under realistic reaction conditions using a unique setup which allows for *in situ* real time monitoring of changes in catalyst size and shape by synchrotron X-ray scattering with simultaneous monitoring of the products formed[5]. Changes in the catalytic particle shape and the evolution of catalyst's reactivity as a function of size and reaction temperature will be discussed and compared to the performance of sub-nm size gold catalysts.

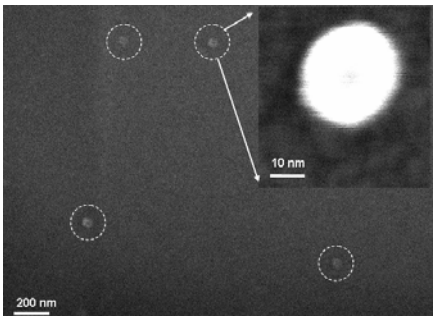

Figure 1. SEM images of the Ag catalyst captured at different magnification.

Oxidative Dehydrogenation of Propane (ODHP). As another example, the use of sub-nm size Pt catalyst supported on mesoporous anodized alumina membranes (AAO) in highly selective and efficient production of propylene from propane will be discussed[5,6].

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