Plasma Synthesis of Nanolayer Carbide Catalysts

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The focus of the research work has been to develop the scientific understanding necessary to use a successfully developed low temperature plasma, electric particulate suspension generated, non-agglomerated cloud, synthesis method to produce, in a controlled manner, catalytically active nanolayers of carbides of transition metals, particularly molybdenum carbide, as alternative catalysts for platinum. The catalytic activity of the plasma synthesized molybdenum carbide nanolayers has been demonstrated in preliminary tests and is found to be greater than that from commercially available bulk powder molybdenum carbide.

The formation of nanolayered structures on the surface of the plasma treated particulate materials differs substantially from conventional non-thermal plasma assisted processes such as coating and surface modification. It involves complex multiphase transport of reacting species from the plasma volume to the material surface, then diffusion and possibly chemical reactions beneath it. Monitoring carbide product characteristics as a function of particulate cloud formation, plasma power, pressure, gas composition, and processing time to provide basic knowledge of the plasma-material interaction is challenging but necessary for achieving controlled processing.

The potential advantage of accentuated catalytic activity of the carbide nanolayers, compared with platinum, coupled with the generally accepted advantages of plasma processing – reduced costs, lower energy requirements, reduced processing time, and increased production quality – suggest very significant improvements over current synthesis methods are possible if the challenges of monitoring the processing can be addressed.