

Post-DBD-plasma silica coating of gasborne metal nanoparticles

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Nanoparticles are employed in a wide variety of applications including catalysis and functional coatings. However, the inherent instability of small metal nanoparticles at elevated temperatures limits their range of application or their processing, e.g. in the calcination of particle layers to the substrate to obtain robust coatings. While the thermal stability may be improved by a silica coating of the nanoparticles, a hampering of the accessibility of the active particle surface, e.g. for heterogeneous catalysis, has to be avoided at the same time. So far these two opposing requirements have been addressed by permeable silica coatings as a consequence of cracking under heat treatment [1] or the use of pore builders [2]. However, not all materials can withstand higher treatment temperatures and the liquid route for porous silica coatings is rather tedious and time consuming [2].

The aim of this contribution is to present a simple method to apply a defined silica coating on arbitrary core nanoparticles by mixing the aerosol particles with TEOS vapour and reactive species from a DBD plasma. Due to the reaction of the TEOS vapour with the ozone (and probably some nitric oxides) formed in the DBD plasma an intermediate species is formed which condenses on the nanoparticles. This liquid coating may reach a thickness of several 10 nm, quite independent of the core particle size (cf. Fig.1).

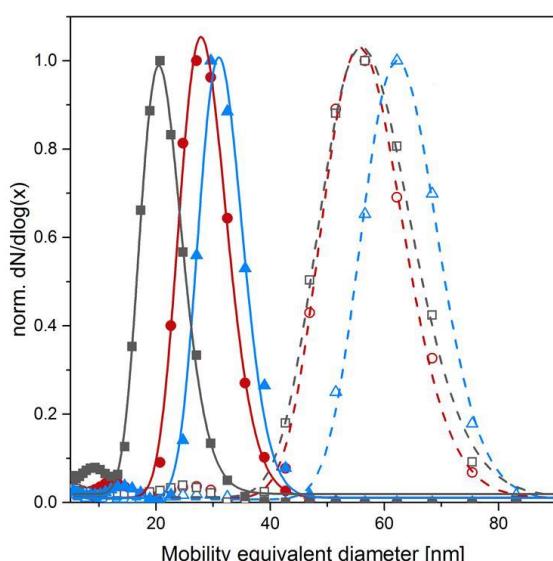


Figure 1. Initial Pt nanoparticles (filled symbols, left) and after condensation of intermediate vapour (open symbols, right)

However, the final solid silica coating forms only afterwards in a rather slow reactions which may take several minutes to be completed. Therefore, the control of the TEOS concentration and the reaction time allows a meticulous control of the coating characteristics (cf. Fig. 2). In fact, it was even achieved to place the silica only into the necks between the primary particles of agglomerates leaving the active area of Pt nanoparticles virtually unaffected by the coating.

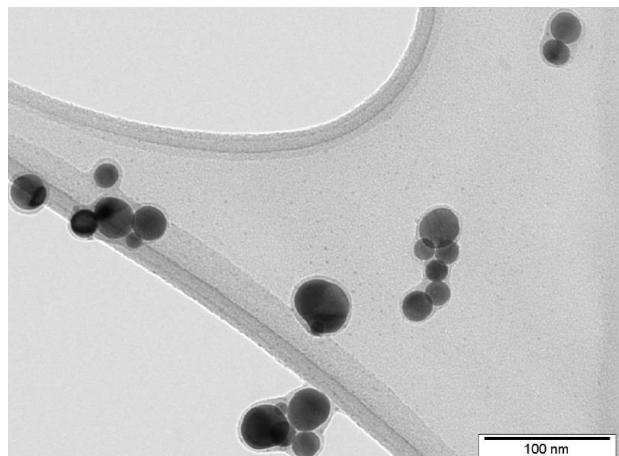


Figure 2. TEM micrograph of coated Pt nanoparticles

The post-DBD coating method and results confirming the improved temperature stability as well as the retained photoactivity of Pt nanoparticles will be presented.

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