Atomic Layer Deposition of Palladium Nanoparticles for Catalytic Applications

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Platinum group metals such as Pt, Ru, Pd, Ir, etc., have superior performance for various catalytic applications [1]. Due to their scarcity, efforts were being made to reduce or replace these noble metals. Atomic Layer Deposition (ALD) is one among the best technique to facilitate lowering of loading mass on a support of interest [2,3]. Furthermore, ALD is the most suitable technology that can decorate high aspect ratio and high surface area substrate architectures [4]. Due to the governing surface energy variations between noble metals and support surfaces, the growth initiates as nanoparticles (NP) and with a further increase in ALD cycles the agglomeration among NP's dominates over the individual NP size increase, thus developing thin films of relatively higher thickness. The surface energy variations are also known to increase the nucleation delay of noble metals including Pd. In this regard our efforts were laid to improve the functionality with pretreatments on carbonaceous supports which were shown promising to reduce the nucleation delay of ALD deposited Pd.

For electrocatalytic applications, it is important to choose the right substrates. Among the available ones, carbon papers (CP) and titania nanotube (TNT) layers are best choices considering their physio-chemical properties, availability, vast literature, and low costs incurred using these as support substrates in electrocatalysis and photocatalysis. Several surface modifications for CP's and variations on morphological aspects of TNT layers had attracted a great attention form applied fields due to their improved surface area, conductivity, and stability [5-8]. Uniformly decorating these CP's and TNT layers by NPs of catalysts proved to be highly efficient with no boundaries on applications, as shown in our recent papers [9-10].

The presentation will introduce and describe the synthesis of Palladium NPs by ALD on CP substrates [9] and TNT layers with high aspect ratios [10]. It will also include the corresponding physical and electrochemical characterization and encouraging results obtained in electrocatalysis.

References

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