# Synthesis of dispersible core-shell metal@oxide materials and their application as stable fuel cell catalysts

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The ability to design and prepare materials with atomic scale accuracy is of paramount importance in order to gain new and interesting properties for catalytic materials. Core-shell structures are of particular interest due to the fact that interactions between components, such as a metal and its support, can lead to improved properties over that of the constituent single-component counterparts. An additional attractive characteristic of core-shell structures in catalysis is the possibility of preserving the size of the active metal particles, even after severe thermal treatments, due to the effect of encapsulation. However, while the idea of core-shell catalysts is promising, there are difficulties dispersing core-shell structures into usable forms that are not aggregates of particles and most of the literature on metal/metal oxide core shell structures deals with one of the less interesting oxides, silica, as the shell due to the well known chemistry of its precursors.

Here we report the synthesis of dispersible M@oxide core-shell structures, where M can be Pt or Pd and the oxide can be ceria, zirconia, or titania. We describe the pre-organization in solution of the components leading to M@oxide core-shell structures dispersible in organic solvents such as THF, dichloromethane, toluene and hexane. Our strategy exploits functionalized monolayer-protected Pd or Pt nanoparticles and an alkoxide as building blocks (Figure 1).[1] Using Pd@ceria, we then demonstrate that the dispersible M@oxide structures can provide greatly enhanced thermal stability in SOFC anodes compared to metal particles prepared by traditional impregnation using metal salts.[2] The promise of applying this same approach to other metal-metal oxide combinations is currently under study.

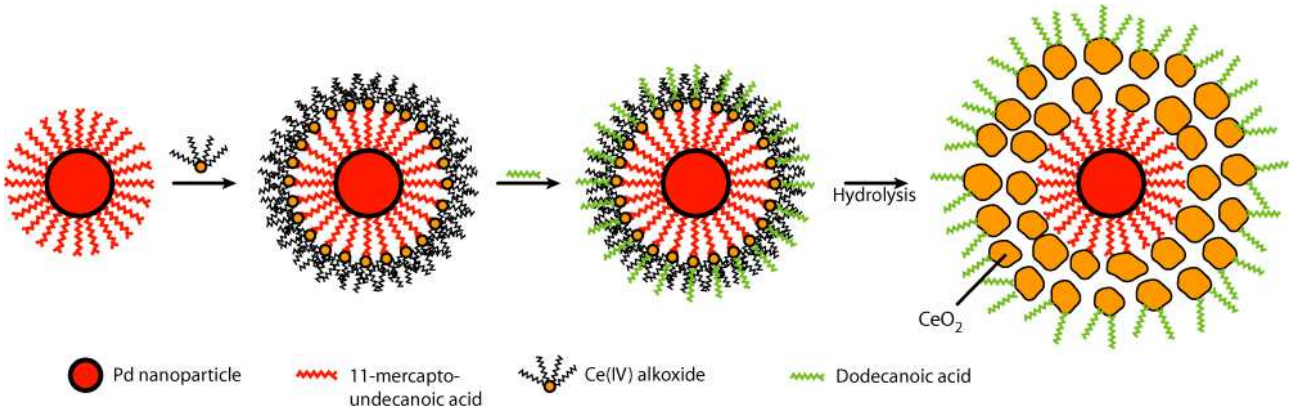


Figure 1. Schematic representation of the procedure employed to prepare dispersible Pd@$CeO_2$ nanostructures.

## References

[1] M. Cargnello, N. L. Wieder, T. Montini, R. J. Gorte and P. Fornasiero *J. Am. Chem. Soc.* **2010**, *132*, 1402.
[2] J.-S. Kim, N. L. Wieder, A. J. Abraham, M. Cargnello, P. Fornasiero, R. J. Gorte and J. M. Vohs, *J. Electrochem. Soc.* **2011**, *158*, B596-B600.