

Structures and Characteristics of noble metal nanoparticles in nanocomposites & gels via exfoliated clay mediated in-situ reduction

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Abstract

Noble metal nanoparticles (NPs) such as Pt, Pd and Au NPs are currently used in many fields, including catalysis, electronics, and biological technologies, owing to their unique size-dependent structures and properties. The development of noble metal NPs-based nanocomposites (NCs) for highly functional materials is a continuously expanding research topic. Here, we focus on clay which is a low-cost inorganic mineral with a layered structure and has generated significant interest because of its attractive properties such as ordered structure, intercalation capability, network formation^[1] and high exchange capacity.

Recently, we proposed a novel synthetic route to Pt/Clay NC system via clay-mediated in situ reduction under mild conditions, without using any organic modifiers.^[2] The Pt/Clay NCs with Pt NPs (3–6 nm) (**Figure 1**) anchored onto the clay nanoplates exhibit a very large surface area,^[2] high thermal stability^[2,3] and outstanding catalytic activity for the reduction of 4-nitrophenol^[2] and the carbon monoxide oxidation.^[4] Subsequently, we reported the synthesis, structure, and properties of a novel hydrogel-based nanostructured Pt materials, Pt-NC gel,^[5] consisting of ultrafine Pt NPs (0.5–3 nm) strongly immobilized within a unique polymer-clay network (**Figure 2**). Ultrafine PtNPs were also obtained as a stable suspension from the NC gel, without any stabilizing agents. The combination of ultrafine Pt NPs and mechanically tough NC gel may open up new possibilities for designing functional Pt-gel materials. Furthermore, we reported a new clay-mediated one-pot preparation of various bimetallic core-shell nanocrystal-clay composites (**Figure 3**) with well-defined shapes and unique catalytic features.^[6] In particular, the catalytic activity was significantly improved in Au(core)-Pd(shell)/Clay NCs. In the presentation, we discuss on the structures, stabilities and functions of noble metal nanoparticles (Pt, Pd, Au) in these NC (and gel) systems.

References

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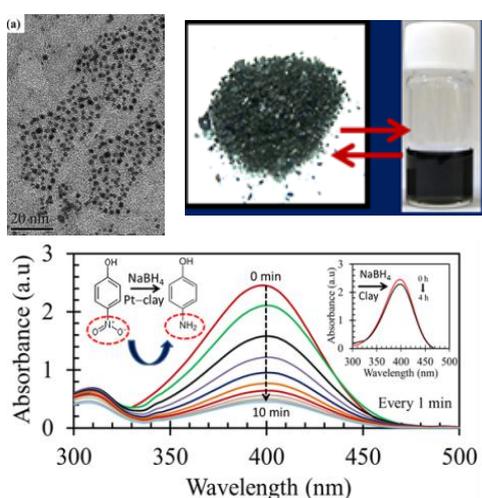


Figure 1

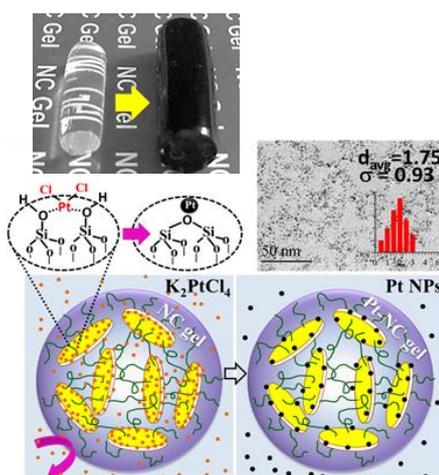


Figure 2

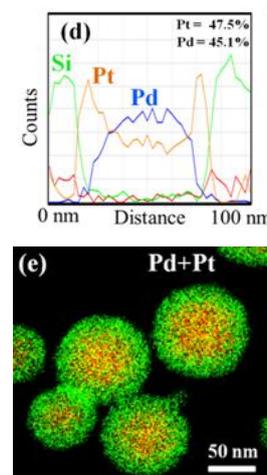


Figure 3