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Advanced Materials 2018: One-pot synthesis of hybrid nano particles for catalytic applications- Heeyeon Kim- Korea Institute of Energy Research

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We have developed facile CVD techniques for the synthesis of metal hybrid nano-catalysts used for cell or secondary battery. By using the CVD technique, we will easily obtain the right catalytic structure and manipulate the microstructure of the nanometal catalysts. it's noteworthy that the traditional multi-step synthetic processes are often simplified into a single-step process or a sequential process by these processes. For the single-step CVD synthesis of Pt nanocatalyst decorated with porous graphene shells, MeCpPtMe3 was used as a precursor of Pt nanoparticles. For the synthesis of graphene shells, various hydrocarbon precursors like acetylene, acetone or ethyl alcohol were used as precursors, which were vaporized and simultaneously flowed into the CVD reactor. For the low-temperature synthesis of bimetallic nanoalloys for cell electrode, we applied a one-pot sequential CVD technique. For the synthesis of Pt-Co bimetallic nanoparticles, MeCpPtMe3 was vaporized and flowed into a CVD reactor, where lampblack was placed as support of Pt-Co bimetallic catalyst. For Co deposition, CpCo(CO)2 was vaporized and flowed into the CVD chamber. Then, the Pt with Co nanoparticles deposited on lampblack was annealed for the synthesis of Pt3Co bimetallic nanoparticles. By single-step CVD technique, Pt with porous graphene shells was synthesized, which showed higher efficiency compared to reveal Pt and maintaining long-term stability after extended potential cycling which is thanks to the protective effect of graphene shells. Also, our sequential CVD techniques for bimetallic Pt-Co nanocatalyst are efficient for the fast, simple and straightforward synthesis of optimal catalytic structure. This system is extremely useful for lowering the synthetic temperature of metal alloys by quite 200°C compared to standard processes. Introduction: Very intense research activities are devoted during the past decade to the elaboration of hybrid nanoparticles so as to together several complementary properties within the same very small object. As a first example, Weissleder reported pioneering works handling the event of triple label nanoparticles.1Core/shell structure nanoparticles supported polysiloxane coated gadolinium oxide doped with Tb3+ions were found to beefficient for the detection of biomolecules.2As another example, iron oxide nanoparticles coated with a PEGylated copolymer were prepared and used as contrast agents for in vivo resonance imaging (MRI).3In an equivalent way, multimodal contrast agents for MRI were developed from the previously described hybrid nanoparticles supported Gd2O3coated with a polysiloxane shell, encapsulating an organic fluorophore and carrying PEG chains onto their surface.4More recently, it had been also demonstrated that adding gold inclusions within silica particles containing fluorescein allows the suppression of the self-quenching phenomenon. All of those examples illustrate well the concept of a multifunctional hybrid platform, namely a really small object engulfing organic and/or inorganic nanoparticles and displaying additional functionalities like a stealthy character, a molecular recognition, or reduced toxicity by pertinent coating. additionally , the colloidal stability of those nano-particles over an extended period has got to be ensured. Some interesting coatings could also be planned so as to fulfill two requirements simultaneously, the simplest known of them being PEG: additionally to he steric stabilization, the PEG coating reduces the detection of nanoparticles or liposomes by the system then the reticular endothelial uptake of nanoparticles, thus increasing their circulation time within the body. Therefore, the final properties and further applications ofthese multifunctional hybrid platforms are closely related to theirsurface chemistry, which needs to be well-controlled.

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