Molecularly dispersed active species coordinated on carbon-based materials and their catalytic applications

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The generation of molecularly dispersed active species on the surface of carbon-based network enables to utilize advantages of molecular catalysts as well as to extremely expose active species without aggregation at the surface. In this presentation, I will discuss my recent research activities on this concept. Novel hybrids were generated by the reaction of Co-containing organometallic molecules and carbon-based materials such as chemically modified graphenes, carbon nanotubes, and carbon nitrides.

Various chemical analyses confirmed the preservation of the molecular organometallic structure in the complex as well as coordination of N-containing species of the carbon-based materials to the metal atoms. The Co-based hybrids showed excellent electrocatalytic activity for the oxygen reduction reaction (ORR) in alkaline media, which is comparable to other Co-based efficient catalysts and a commercial Pt/C. The Ni-based hybrids showed good activity for the oxygen evolution reaction (OER). Both structural understanding and electrochemical measurements with control samples found that the metal-based species were well-dispersed as molecular entity on the surface and served as highly efficient active species for ORR or OER. This approach to catalyst preparation in conjunction with an understanding of its chemical structure and coordination nature is a promising model for the design of advanced catalysts for other important reactions.