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Thesis title: Cobalt Metal/Metal Oxide-based Nanomaterials Supported on Carbon Nanostructures for High-Performance Electro-catalysis

The rational design of high performance and cost effective electrocatalyst is a key for the development of sustainable energy systems such as electrolyzer, fuel cells and metal-air batteries. Although water splitting and fuel cells are commercially mature technologies, they are still limited on large scale production due to the abundancy of the currently utilized expensive materials as well as the sluggish kinetics of the underlying reactions, oxygen reduction reaction (ORR) and oxygen evolution reaction (OER). Therefore, an efficient inexpensive catalyst is necessary.

The work presented in this thesis is well-focused on synthesis and characterization of nanomaterials as an oxygen electrocatalyst for advance energy application. The thesis is based on design and synthesis of cobalt metal-based catalyst as an attractive material for oxygen electrocatalyst. The electrocatalysts that has been proven as most energy efficient in the ORR and OER reactions are the noble metals such as platinum (Pt), iridium (Ir), palladium (Pd), and their alloys, however, as we know these noble metals are extremely costly, rare and do not last long in adverse conditions. Because of their tunable properties and ease of usage, first-row transition metals are widely investigated as feasible and cost-effective alternatives to Pt for ORR and Ir for OER. There has been attempts to build hybrid catalysts, such as heteroatom doped carbon framework, metal alloys and metal oxide composites, and it has helped to improve the performance of electrocatalyst significantly. We investigated the synergism effect between cobalt based nano alloys nanoparticles and conducting carbon support such as graphene oxide (GO) and also for cobalt-based spinel oxides which are decorated over carbon support (GO). These synthesized electrocatalyst are showing enhanced activity towards ORR and OER.