# Metal-Organic Framework Derived Catalysts for Electrochemical Energy Conversion

**Thesis submitted in partial fulfillment for the**

**Award of Degree**

**Doctor of Philosophy**

**By**

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## 6.2. Future scope and perspective

We have established the bulk electrochemical reconstruction of a series of self-supported CoFe-PBAs into ultrathin Fe-$Co(OH)_2$-Co(O)OH nanosheets. The tuned structural as well as electronic properties of the nanosheets with atomic level thickness results in excellent catalytic activity and stability. The thesis work can be further extended to achieve the following points:

(i) The structure of PBA precatalysts can be modulated by tuning the A sites as well as the B sites of the PBAs. The PBAs with the new structure, morphology, and properties can be designed and utilized as precatalysts for electrochemical reconstruction.

(ii) As the electrochemical cathodic reconstruction of self-supported PBA precatalysts has been demonstrated by us, this method can be applied to various PBA precatalysts and can be further explored to achieve new active catalysts for electrochemical hydrogen evolution reaction. In addition, the PBA-derived active catalysts can be further demonstrated for the overall water splitting at high current density.

(iii) The implementation of electrochemically reconstructed active catalysts for water splitting requires mechanistic insight into the active catalyst structure and reaction mechanism of water splitting. Therefore, theoretical investigations namely density functional theory (DFT) can be employed to correlate the structure and activity of the active catalysts.

(iv) The electrochemically reconstructed PBA-derived active catalysts can be employed for the electrocatalytic organic oxidation reaction replacing the kinetically slow anodic OER. The active catalysts can be utilized for the electrocatalytic oxidation of amine, alcohols, glucose, biomass, and urea.

We have already established the electrocatalytic oxidation reaction of benzyl alcohol, benzylamine, phenol, and 5-hydroxymethyl furfural with PBA-derived catalysts. However, these works are beyond the scope of the thesis.

Overall, the work of this thesis provides a clear idea of precatalyst design, their anodic and cathodic activation, and the application of the active catalysts in electrochemical energy conversion processes. The structure-activity relationship of precatalyst-active catalyst and electrocatalytic activity will also be helpful for the designing of highly efficient catalyst systems.