For the growth of any country and to boost the economic system, energy is the foremost factor. In developing countries like India, energy consumption increases quickly due to population growth and development of infrastructures. Energy production from the combustion of fossil fuels creates a big problem for energy conservation and environmental protection for the next generation. Research communities are continuously working to find effective alternatives to these fossil-based fuels. Renewable sources are clean and environment-friendly ways to produce energy. Among the various REs, water-splitting shows great promise in producing green fuel as a hydrogen (H_2) and molecular oxygen (O_2). Driven by two half-reactions, hydrogen evolution reaction (HER) and oxygen evolution reaction (OER), produces a high energy density (120-142 MJ kg^{-1}) of H_2 and pure oxygen, which in turn controls climate change and displays a path for sustainable green fuel. Compared to HER, OER is a more complex reaction and requires a high overpotential to reach the same current density, implying a kinetic barrier of OER. In electrochemical conversion cycles between renewable electricity and chemical fuels in energy conversion and storage devices such as fuel cells, water electrolyzer and metal-air batteries, OER plays a vital role via the generation of pure oxygen in a short period. Therefore, for close-looped clean energy infrastructure and overcoming the shortage of oxygen due to growing pollution, the improvement of OER is urgent.

Ru and Ir-based catalysts are widely used for OER process but the high cost and element scarcity prevent their application at mass level. In view of this, non-noble transition metal oxide nanomaterials with various physical and electronic properties and metal-organic frameworks having well-defined structural designs, high surface area, porosity, excellent thermal and mechanical stability and diverse chemical functionalities are considered promising low-cost alternatives.

The thesis entitled "***Metal-organic framework and nanomaterials for oxygen evolution reaction"*** encompasses the synthesis of spinel materials (Co substituted nickel ferrite) and metal-organic frameworks (MOFs) such as Co-MOF (cobalt metal-organic framework), ZnDTO (zincdithiooxamide) MOF and Ni-Fe PBA-NC (nickel-iron Prussian blue analogue nanocube) for OER. Further, MOFs are used as a precursor to derive heteroatom-doped porous carbon, nanocomposite and various nanostructures from enhancing the OER activity of MOFs. The total thesis has been summarized into seven chapters in which ***Chapter 1*** is the introductory part, ***Chapter 2*** covers the experimental and instrumentation part, ***Chapter 3*** describes the application of spinel-based electrocatalysts of OER, in ***Chapter 4,*** we reported a flower-structured Co-MOF for OER, ***Chapter 5*** deals with the synthesis of nanocomposites of Co_3O_4 and ZnDTO MOF derived N/S/Zn- doped porous for enhanced OER performance, ***Chapter 6*** explores another class of MOF, Prussian blue analogue (PBA) compounds as an OER electrocatalyst, describing the structural transformation of Ni-Fe PBA nanocubes into nanocages and mixed oxide through the engineering of Ni-Fe PBA nanocubes by various chemical process and, ***Chapter 7*** includes the conclusive remarks and future prospects of the thesis.