Structural Reconstruction of a Cobalt Based Metal−Organic Framework during the Electrochemical Hydrogen Evolution Reaction

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Carbon-based fossil fuels have long been essential for human survival and remain the primary global energy source. However, with the rapid industrialization and population growth, humanity is facing an energy crisis and adverse environmental pollution due to the escalating use of these fossil fuels.[1–3] To address this pressing challenge, it is essential to replace the fossil-fuel-based energy system with sustainable alternatives.[4,5] Herein we report the synthesis, characterization, and fate of a newly designed cobalt-based MOF (**CoL1-MOF**) for the hydrogen evolution reaction (HER) in 1 M aqueous KOH. The **CoL1-MOF** exhibited a significant overpotential of 538 mV to reach a current density of 10 mA/cm², while the bare GCE showed negligible activity. Tafel analysis revealed that the HER using this **CoL1-MOF** follows the Volmer–Heyrovsky mechanism. Post-electrolysis PXRD analysis confirmed the formation of metal oxide and hydroxide phases, while morphological changes were observed. Remarkably, the post-electrolysis **CoL1-MOF** demonstrated enhanced HER performance with a reduction in overpotential (440 mV). Overall, this study demonstrates the cost-effective synthesis of 1D transition metal-based MOFs and their potential for sustainable hydrogen production, offering a promising solution to the energy crisis. Salient features of this study will be presented.

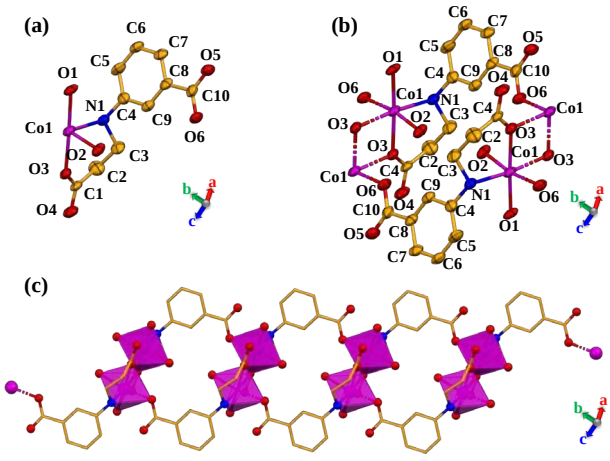

Figure 1: (a) Coordination geometry of **CoL1-MOF**, and **(b)** crystal packing diagram of **CoL1-MOF**. H atoms are excluded for clarity.

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