Title: Design and development of efficient bi-functional catalyst by tuning the electronic properties of cobalt-manganese tungstate for oxygen reduction and evolution reaction

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Abstract: Solid state electrochemistry is drawing considerable interest as the inter conversion of O2 and water playing an important role in energy conversion and storage technology. With an aim of developing an efficient bi-functional catalyst by tuning the electronic properties and local structure around 3d metal in CoWO4, solid solutions Co1-xMnxWO4 are investigated. Nanocrystalline Co1-xMnxWO4 (x= 0 to 1) phases with a unique exposure of low surface energy planes are synthesised by hydrothermal method. Replacing optimum amount of Co with Mn to enhance the catalytic activity correlates with a negative shift observed in the Co2+/3+ redox wave and onset of OER indicating strong electronic interaction between the two elements. Composition corresponds to Co0.5Mn0.5WO4 has demonstrated great ability to catalyse both OER and ORR with a combined overpotential of 0.89 V. It exhibited an OER current density of 10 mA cm-2at an overpotential of 400 mV. While, ORR current density of 3 mA cm-2 is reached at a potential of 0.74 V vs. RHE. The density functional theory revealed that the substitution of Mn in CoWO4 elevate the 3d metal d band centre closure to fermi energy and hence ease the electron transfer to facilitate ORR-OER.