Nickel phosphides on cellulose platform as an effective electrocatalysts towards hydrogen and oxygen evolution reactions

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With the environmental problem increase and the depletion risk of fossil fuels, there is an urgent need for an efficient, clean and sustainable source of energy, as well as new technology associated with energy conversion and storage. One of the most promising approach to overcome these issue may be the overall electrochemical water splitting to hydrogen and oxygen to produce energy. Hydrogen evolution reaction (HER) and oxygen evolution reaction (OER) are basic reaction of this process. However, commercially used electrocatalyst are based on noble low earth abundance and expensive metals (e.g. ruthenium, palladium iridium). Therefore there is a need to develop new electrocatalysts based on non-noble metals, which will be cheaper and possess improved electrocatalytic properties.

On the past few decades, remarkable efforts have been made to develop non-precious metal based electrocatalysts for HER and OER reactions. The earth-abounded transition metal compounds attract much attention of scientists due to economic advantages and their specific electronic structure. From all of the transition metal compounds, transition metal phosphides (TMPs) have gained exceptional attention in this field due the their electrochemical activity, high conductivity and stability, corrosion resistance and many more. In particular, nickel phosphides, which possess unique electronic properties, efficient electrocatalytic activities, and anti-corrosion features, have attracted significant research attention and are recognized as efficient and low-cost HER and OER catalysts [1]

In this work different shapes of nickel phosphides on the platform composed of cellulose fibers will be discussed. Characterization methods results from transition electron microscope (TEM) and scanning electron microscope (SEM), x-ray powder diffraction (XRD) as well as x-ray photoelectron spectroscopy (XPS) will be consider. All materials were examined towards HER and OER reactions. Electrochemical properties, such as overpotential, Tafel slope and stability were evaluated. Prepared samples exhibit promising results towards electrochemical oxygen and hydrogen evolution reactions.

[1] C. Hu, C. Lv, S. Liu, Y. Shi, J. Song, Z. Zhang, J. Cai, A. Watanabe, Catalysts, 10(2), 188 (2020).