In-situ synthesis and electrochemical activity of Mo_2C/Mo_2N nanohybrid as an efficient HER application

Rajinder Kumar, Ritu Rai, Zubair Ahmed, Vivek Bagchi*

Institute of Nano Science and Technology (INST), Mohali-160062, Chandigarh, India.
E-mail: rajinder4iit@gmail.com

Abstract: Industrial revolution has made the life simple but along with this development the industrial and house hold energy requirements have gone many fold increased. Most of the energy needs are fulfilled by the fossil fuels. The use of fossil fuels not only hampers our ecology system but also it has negative impacts on physical health also[1]. The energy demand and the universal environmental concern has push the mankind to develop low-cost and highly efficient renewable energy sources that fulfills both criteria of ecological neutral and human friendly. Wind, solar, biofuels, sea-tides energy and electrochemical water splitting terms out to be best alternative for the energy purpose. Water splitting is the main source of hydrogen and oxygen production. Hydrogen could be the best alternative as an energy carrier and water splitting seems to be best and the efficient way of hydrogen production. Electrochemical hydrogen evolution is the safe and effective process to generate hydrogen. Generally, the reactions kinetic are very slow but the use of supporting electrocatalyst helps in enhancing the reaction kinetics[2]. Pt is well known and universally accepted well known catalyst till date. The use of Pt and its derivatives increases the hydrogen production cost many fold at industrial scale. Despite high efficiency for HER, noble metal electrocatalysts like Pt, Pd and there composites are not cost-effective for hydrogen production due to their high cost and low abundance.

The development of cost-effective and efficient electrocatalysts for the hydrogen evolution reaction (HER) is attractive approach for energy conversion and storage processes. These moderately efficient electrocatalyst could play a vital role in hydrogen generation. Transition metals and there derivatives has emerged out to be efficient electrocatalyst these days. Specially, the molybdenum and its derivatives have shown remarkable electrochemical activity towards hydrogen generation. Here, we have reported a new and efficient non-noble nanohybrid for HER application. The electrocatalyst based on dual phase synergy of the system. In this work, Mo_2C/Mo_2N nanohybrids were synthesized via two-step high-temperature calcination. As mentioned earlier Mo_2C is a possible substitute to Pt-group metal for HER application. *In-situ* synthesized nanostructure containing molybdenum carbide and molybdenum nitride nanoparticles of size ranging from 8 to 12 nm, exhibits excellent HER catalytic activity. The molybdenum based catalyst (MoCat) is designed as precious-metal-free, highly stable electrocatalyst for water electrolysis in acidic medium. These nanoparticles (β-Mo_2C and γ-Mo_2N) were produced using a metal precursor along with the C/N source in an inert atmosphere. An overpotential of 96 mV for driving 10 mA/cm^2 of current density was measured for MoCat catalyst, which is very close to commercially available Pt/C catalysts (61 mv)[3].

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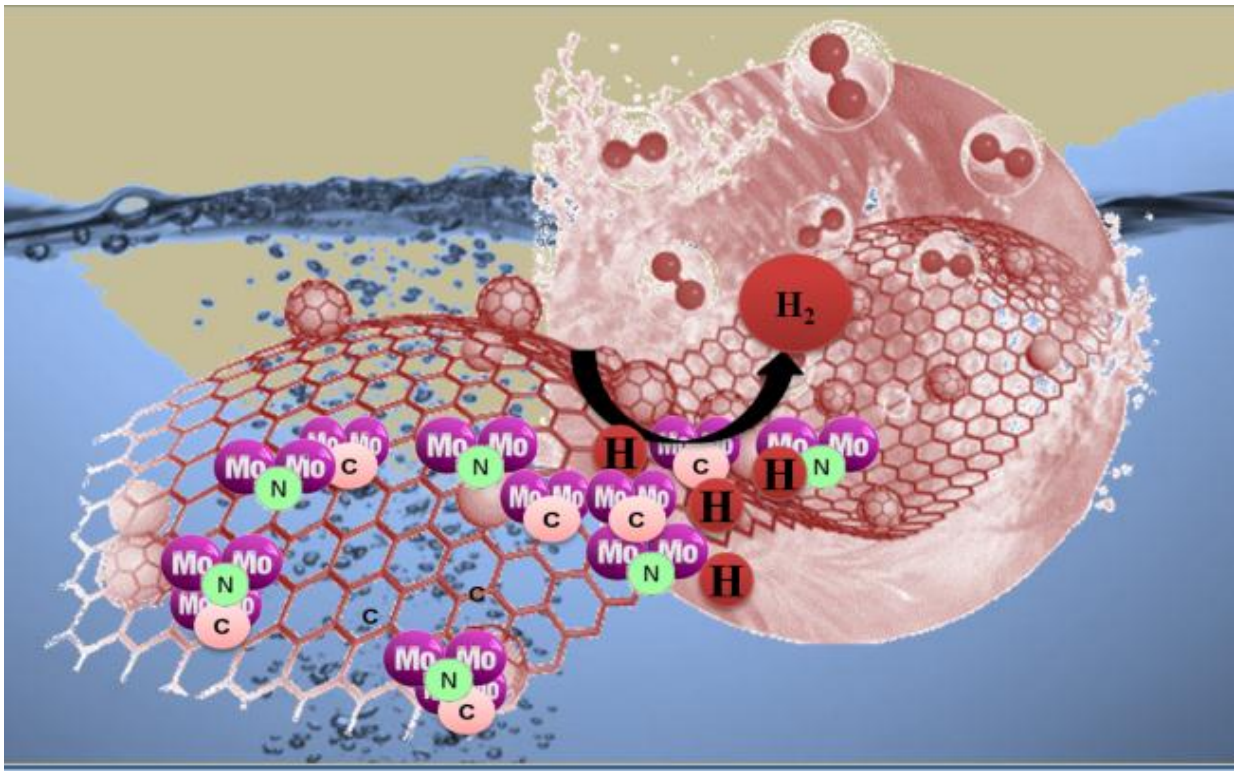

Figure 1: Schematic showing hydrogen evolution process at electrode surface containing Mo_2C/Mo_2N nanohybrid.

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