A Bifunctional System for Atmospheric Water Harvesting and Direct Air Electrolysis for Hydrogen Production

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Hydrogen is a clean energy carrier and a promising candidate for realizing carbon-neutral systems, as its only byproduct is water. However, the lack of clean water is a significant barrier to the production of hydrogen. Herein, for the first time, a system has been developed for direct air electrolysis that uses the harvested water in direct air electrolysis to produce hydrogen. MOF-801 and MOF-303 were synthesized through the microwave method. Then, the synthesized MOF's were post-synthetically doped with Pd/C as an electro catalyst that can harvest water and convert it electrochemically into hydrogen. All synthesized materials were successfully characterized using XRD, SEM, and BET. The MOFs synthesized via microwave showed high surface areas of 753 m2g-1 and 1330 m2g-1 for MOF801 and MOF303, respectively compared to 500 m2g-1 and 1300 m2g-1 for the traditional solvothermal methods. In order to investigate the water harvesting performance of the synthesized materials, water isotherms were measured for the MOFs before and after modification, which reached 50 wt% for MOF303. The GC reflected that the custom-made design cell and the prepared catalysts can directly produce hydrogen. The results showed that when the MOF was introduced to the catalysts, outstanding enhancement in the water interaction was achieved. This system can potentially be implemented in energy plants to support the reliable and effective delivery to applications in vehicles, housing and off-grid storage, In terms of water, water management facilities in arid regions globally could use the device to sustain plants and a provide potable and non–potable daily supply.

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