Water splitting

Among the solar fuel technologies, water splitting is a relatively mature technology that uses renewable electricity and water to produce H_2. Storing renewable energy as H_2 is a solution for the intermittency problem of solar cells and wind turbines. Moreover, a large amount of H_2 is produced in non-renewable ways every day for important industrial processes. Replacing that H_2 by the H_2 obtained using water splitting would significantly reduce the CO_2 emissions and its impact on the climate.

Water splitting consists of two half-reactions at two different electrocatalysts (cathode and anode, see illustration below). H_2 is produced at the cathode, while O_2 is produced at the anode. Scientists have studied both of these catalysts to improve their efficiency and stability. However, these studies have been carried out at different conditions for each half reaction catalyst (e.g., different electrolytes). In a real water splitting device, the same conditions are used. Moreover, in order to make water splitting a reality, real water sources with impurities need to be tested.

Challenges

One of the main challenges in water splitting is to research the complete device in realistic conditions more efficiently, which involves optimization of two catalysts in one device. In order to optimize these two catalysts to obtain an efficient, stable and economically feasible water splitting process, screening for new catalytic materials needs to be made more efficiently, with innovative synthesis processes.

TECHNICAL INPUT

Particle Source	VSP-G1 & VSP-S1
Deposition Method	Diffusion & Impaction
Deposition System	VSP-A3 or S1
Deposition Parameters	N/A
Sample	Conducting substrates
Material	Transition metals
Application	Water splitting
Analysis technique	TEM

Solution

The nanoparticle generator (VSP-G1) of VSPARTICLE allows to produce transition metals of virtually any alloy composition with control over the particle size and mesoscopic properties (e.g., surface area, porosity, etc). The operation of the G1 is at ambient temperature and pressures, which allows a quick exchange of target materials. This way, our technology can help accelerate (i) the optimization of complete electrochemical devices (see set-up 1 below) and (ii) the research of individual materials (see set-up 2 below).

Example experiment setup

1) Nanostructured catalysts with control over the primary particle size, composition and mesoscopic properties (e.g., porosity):

2) Well-separated particles with control over the size and composition:

Optimization of complete electrochemical devices