Dr. Marco Schönig

Titel: Nanoconfinement in electrocatalysis

Abstract:
The societal transformation to renewable energy is inseparably connected with more efficient ways to store energy. Electrochemistry is generally considered to offer prime storage solutions, by either direct energy storage in batteries or supercapacitors (SCs) or by using electrocatalysis to convert energy in useful products, e.g., green hydrogen. The key step in electrochemical processes is the transfer of charge across the interface between the electrode and the electrolyte. The efficiency of such processes can be enhanced, by increasing the surface of the electrode. Increase of surface area can be achieved by introducing pores in the materials, which at the same time ensures low mass and volume of devices.
Porous materials have led to significant advances in the past, e.g., the development of Li-ion batteries. However, in recent years the porosity of materials has reached the nanometre scale. At this scale, the pores in the material become so small that new effects emerge that deteriorate the performance. These effects are caused by confinement of the crucial elements of this interface, i.e., the interfacial layer known as double-layer, as well as the ions at the surface. The SC research field pioneered ways to use nanoconfinement of ions to enhance the charge storage capacities of SCs. On the contrary, in electrocatalysis the utilization of nanoconfinement effects is still scarce.
In my project "NanoC_3", we aim to transfer the knowledge from SC research to electrocatalysis, to understand the effect of confinement of ions and of the double-layer on charge storage and hydrogen production. For this purpose, we will analyze novel materials, with unprecedented control of the pore size, provided through collaborations with material scientists, with innovative surface science techniques.