2D Nanostructures at Atomic Scale: From Energy an Environmental Applications to Quantum Devices

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Abstract

Technology at the nanoscale has become one of the main challenges in science as new physical effects appear and can be modulated at will. As developments in materials science are pushing to the size limits of physics and chemistry, there is a critical need for understanding the origin of these unique properties and relate them to the changes originated at the atomic scale, e.g.: linked to structural changes of the material, many times related to the presence of crystal defects or crystal surface terminations. Especially on 2D materials designed for electrocatalysis in energy and environmental applications, crystallography and distribution of the atomic species are of outmost importance in order to determine the active sites that will improve the reaction performance, including efficiency and selectivity towards certain reactions. In 2D nanomaterials the distribution and coordination of metal species at the surface are determining their final electrocatalytic behavior as the reactions of interest mainly occur at the surface. The presentation will show how pristine and perfect crystalline surfaces may tend to be inert versus particular reactions, while creation of certain types of defects or even a predetermined surface amorphization may highly improve the catalytic activity of these 2D nanomaterials [1-4].

In the present work, a combination of advanced electron microscopy imaging with electron spectroscopy, in an aberration corrected STEM will allow us to probe the elemental composition and structure in a high spatial detail, while determining the growth mechanisms and correlating the structural properties to their physical and chemical properties [5].

References
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[3] T Zhang et al, Energy & Environmental Science **14** (2021), p. 4847.
[4] Z Liang et al, Advanced Energy Materials **11** (2021), 2003507.
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Figures

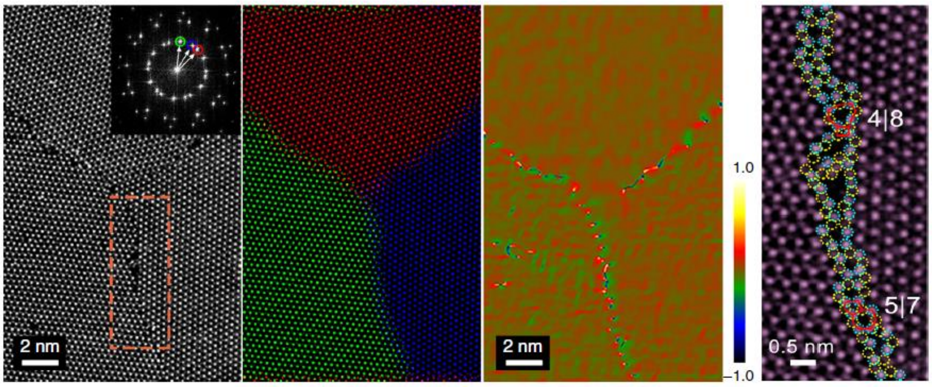

Figure 1: AC HAADF STEM magnified example of a triple grain boundary and a detail of the complex bonding coordination [1].