

## Sonia Conesa-Boj

Department of Quantum Nanoscience, Kavli Institute of Nanoscience, Delft University of Technology, 2600 GA Delft, The Netherlands

s.conesaboj@tudelft.nl

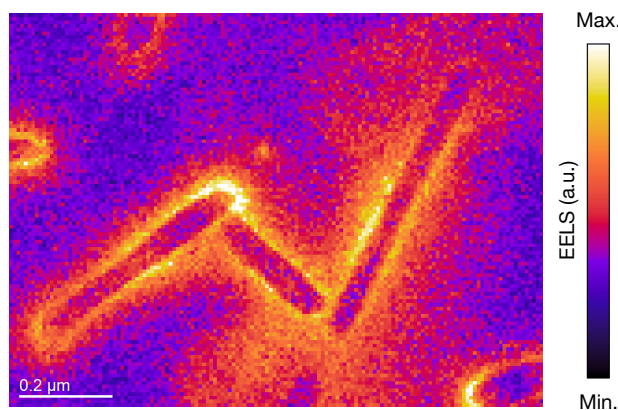
## From crafting to visualization: low-dimensional TMD nanostructures under the electron microscope lamppost

One of the driving forces of the ongoing nanotechnology revolution is the ever-improving ability to understand and control the properties of quantum matter down to the atomic scale. Key drivers in this revolution are quantum materials, such as the two-dimensional (2D) materials of the transition metal dichalcogenide (TMD) family. The realization of novel TMD-based devices relies heavily on understanding the relation between structural and electrical properties at the nanoscale. The ultimate goal is that of crafting TMD nanostructures in a way that makes possible the tailored control of their properties. In this talk, recent studies illustrating novel fabrication approaches of TMD nanostructures based on combining top-down and bottom-up methods will be presented. These allow to control the resulting geometries and material combinations, making possible the realization of novel functionalities such as metallic edge states arising in MoS<sub>2</sub> nanowalls [1] and nanowires, enhanced nonlinear response in vertically-oriented MoS<sub>2</sub> nanostructures [2], and surface and edge plasmons in WS<sub>2</sub> nanoflowers [3]. I will emphasize the crucial role that cutting-edge transmission electron microscopy techniques play in these studies, together with that of machine learning techniques [4] which make possible extract a wealth of novel information which would be lost otherwise.

### References

- [1] M. T. Rivas, L. Maduro and S. Conesa-Boj, *Scientific Reports*, 9 (2019) 15602.
- [2] M. Bolhuis, J. Hernández-Rueda, S. E. van Heijst, M. Tinoco Rivas, L. Kuipers and S. Conesa-Boj, *Nanoscale*, 12 (2020) 10491.
- [3] Sabrya E. van Heijst, Masaki Mukai, Eiji Okunishi, Hiroki Hashiguchi, Laurien I. Roest, Louis Maduro, Juan Rojo, and Sonia Conesa-Boj, *Ann. Phys.* 2000499 (2021).
- [4] Laurien I. Roest, Sabrya E. van Heijst, Louis Maduro, Juan Rojo, and Sonia Conesa-Boj, *Ultramicroscopy*, 222 (2021) 113202.

### Figures



**Figure 1:** Experimental study of low-loss EELS acquired in MoS<sub>2</sub> nanotubes. Intensity map of the EELS signals integrated for a energy-loss window between 1-2 eV.