"A system for imaging nanoscale properties of 2D materials with atomic force microscopy under uniaxial strain"

Álvaro Rodríguez
Onur Çakıroğlu, Yigit Sozen, Juan J. Riquelme, Carmen Munuera, Andres Castellanos-Gomez
Instituto de Ciencia de Materiales de Madrid (ICMM-CSIC), Sor Juana Inés de la Cruz, 3, Madrid, Spain.
alvaro.rodriguez@csic.es

In this study we introduce a system for imaging nanoscale properties using atomic force microscopy (AFM) under controlled uniaxial strain. We measure topography changes at the nanoscale under externally applied strain, showing the evolution of typical heterogeneities such as bubbles, wrinkles, and the appearance of cracks. Notably, we demonstrate the capability to conduct in operando Kelvin probe force microscopy (KPFM) measurements, offering insights into the surface potential of mechanically exfoliated 2D materials such as MoS_2 or WSe_2. The system can be seamlessly integrated with Raman or reflectance mapping techniques, providing a comprehensive characterization platform for nanoscale properties under controlled uniaxial strain conditions. [1] This integrated approach enhances our understanding of the correlation between mechanical strain, nanoscale morphology, and optical behaviour, facilitating the design and optimization of advanced nanomaterial-based devices.

References

[1] O. Çakıroğlu, J. O. Island, Y. Xie, R. Frisenda, A. Castellanos-Gomez, An Automated System for Strain Engineering and Straintronics of 2D Materials. *Adv. Mater. Technol.* 2023, 8, 2201091