In-Situ STEM Phase Transformation Study of 2D Materials

Moon J. Kim[1]
X. Zhu[1], S. Kwon[1], Q. Wang[2]
[1]*Department of Materials Science and Engineering, The University of Texas at Dallas, Richardson, Texas, 75080, U.S.A.*
[2],*Materials Science and Engineering, King Abdullah University of Science & Technology, Thuwal, 23955, Saudi Arabia*
moonkim@utdallas.edu

The physical properties of numerous two-dimensional (2D) materials, such as transition metal dichalcogenides (TMDs) and transition metal carbides (TMCs), are intrinsically governed by their phase, atomic scale morphology, and defect structures [1-3]. However, there is a lack of detailed investigations of the stability and transformational dynamics of these 2D materials upon exposure to an external stimulus, a facet of paramount significance for their pragmatic applications. critical for their practical applications. Employing in-situ scanning transmission electron microscopy (STEM), our study aims to unravel the intricacies of thermally-induced phase transitions and defect evolution in 2D materials at the atomic scale. This presentation will proffer a compendium of illustrative instances featuring emergent 2D materials such as $Cr_2Ge_2Te_6$, $NbSe_2$, and high-entropy TMC. Details of various physical and chemical transformations observed, such as new phase formation, 2H to 1T phase transition, defects, atomic desorption, intercalation processes, and more, will be presented and discussed, as illustrated in Figure 1.

References

[1] S. Hatayama, et al., MRS Commun. 8 (2018), 1167.
[2] H. Wang, et al., Chem. Soc. Rev. 44 (2015) 2664.
[3] R.Benitez et al., Acta Mater. 143 (2018) 130.

Figures

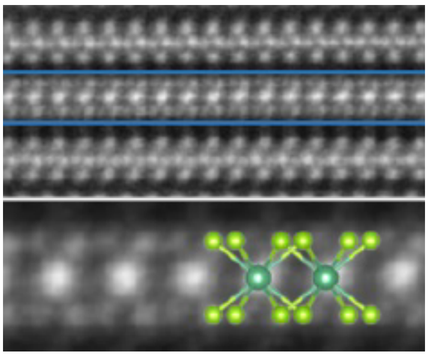

Figure 1: Atomic-resolution STEM images showing the phase transition of NbSe2 from its 2H to 1T structure at 400°C.