Metrology for defects characterization and interface control for 2D materials

Umberto Celano
Ira A. Fulton Schools of Engineering, Arizona State University, Tempe, AZ, 85287 USA
Umberto.celano@asu.edu

Abstract

While 2D materials are being seriously evaluated by the semiconductor industry for next generation ultra-scaled devices, we aim to emphasize the present limits of metrology for 2D materials, and the increasing role of physical analysis techniques for device manufacturing using atomically-thin materials. Here, an overview of current, emerging, and disruptive measurement techniques is covered. The work is meant to provide a clear understanding of 2D materials design requirements, growth, and integration options, and how these affect measurement requirements in an environment where fast, wafer-scale analytical methods will be needed. We review some of the alternative physical analysis techniques in modern IC metrology and their counterpart application for 2D materials, more importantly we describe the fundamental measurement science limits associated with these techniques when applied to 2D materials. Finally, we focus on the need for dedicated metrology solutions that can address the specific challenges introduced by 2D materials. We highlight key "must meet" measurement challenges outlined in current technology roadmaps and assess the capabilities of different measurement methods to meet those challenges, with detailed description of critical measurement challenges with no current solution.