

A Roadmap for Disruptive Applications and Heterogeneous Integration Using Two-Dimensional Materials: State-of-the-Art and Technological Challenges

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This talk will attempt to establish a roadmap for 2-Dimensional (2D) material-based Nanoelectronic technologies for beyond Si and other future/disruptive applications with a vision for the semiconductor industry to enable a universal technology platform for heterogeneous integration. The heterogeneous integration would involve integrating orthogonal capabilities such as different forms of computing (classical, neuromorphic and quantum), all forms of sensing, digital and analog memories, energy harvesting, etc. – all in a single chip using a universal technology platform. This talk will also cover the technological and fundamental challenges in pushing the 2D technology to the market, where the world stands today, and what gaps are required to be filled. Talking about the gaps, I will particularly touch base on the Metal (3D) to graphene/TMD (2D) contact engineering challenges, which has been considered as one of the most fundamental challenges towards harnessing the full potential of 2-dimensional materials. And, how the fundamental understanding of the contact's quantum chemistry resulted in unique ways to engineer it, resulting into record transistor performance. Besides, I will talk about some of the fundamental process challenges which can unintentionally perturb the 2D channel's electrical, optical and mechanical properties. In the end, I will talk about some of the reliability gaps, which are urgently required to be addressed and the fundamental understanding we have developed so far.