Integration of 2D materials in electronic devices: Challenges and Opportunities

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Two-dimensional (2D) materials have the promise of addressing fundamental property and scaling issues encountered in many different types of devices from memory to analog to logic as well as new applications. The integration of any new material in any electronic device can be long and arduous and the same is true for 2D materials. In comparison to traditional materials used today in electronic devices, the very nature of 2D materials, e.g. atomically thin and surface inertness, makes them particularly difficult to deposit, grow and integrate with other materials to create a device. This is especially true for graphene and hexagonal boron nitride (h-BN) where a catalytic surface is usually used to promote growth of monolayer graphene and h-BN. Because of the need for a catalyst to initiate growth, to use the resulting 2D material it is necessary to remove it from the catalyst surface and transfer it to the desired surface. Transition metal dichalcogenides, another large family of 2D materials have also been extensively investigated due to their diverse electronic properties and are being considered for many applications. The integration of these materials while "easier" because they do not require a catalyst is also challenging because nucleation and growth by heteroepitaxy is not fully developed yet. In this presentation, I will review the challenges and opportunities of integrating 2D materials in silicon device flows for both new applications as well as aiding in the scaling of Si-device technology.