Abstract Submitted
for the CUWIP22 Meeting of
The American Physical Society

**Realizing transfer-free van der Waals heterostructures** ANNIE CHENG, CHENGYU WEN, A. T. CHARLIE JOHNSON, University of Pennsylvania — After the discovery of graphene in the early $21^{st}$ century, there has been much focus on two-dimensional layered materials, also termed van der Waals heterostructures. Since graphene, much effort has been dedicated to exploring hexagonal boron nitride (hBN) and transition metal dichalcogenides (TMDs) such as MoS2, WS2, and WSe2. TMD monolayers have been the subject of much interest due to their fascinating electronic and optical properties. However, the sensitivity of TMDs makes them susceptible to contamination and degradation, with charge impurities at the TMD interface obscuring and degrading electronic and optical performance. Dielectric encapsulation of TMDs with hBN has therefore been suggested as a way of protecting TMDs and improving device performance, since hBN has an atomically flat surface with no dangling bonds, and it has been shown to improve carrier mobility and transconductance in devices. However, the multiple transfers of hBN and TMDs required for dielectric encapsulation often result in contaminants or dopants, adversely affecting the sample. We herein investigate the possible ways of preparing an $MoS_2$-hBN heterostructure through chemical vapor deposition. It was found that, using a precursor solution of ammonium molybdate tetrahydrate and sodium chloride, multilayer $MoS_2$ was able to grow on top of a monolayer hBN surface with the hBN still intact. This demonstrates the promise of large-scale synthesis of $MoS_2$-hBN heterostructures, which would be highly advantageous in future device applications.

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Date submitted: 19 Jan 2022 Electronic form version 1.4