# Novel 2D Chemistry and Superconducting Quantum Engineering

Leslie M. Schoop[1] and Sanfeng Wu[1] ([1]Princeton University)

- MRSEC researchers at Princeton have discovered an on-chip process for growing ultrathin superconductors on ultrathin layers of transition-metal dichalcogenides (TMD). Palladium is fabricated in contact with exfoliated TMD that are encapsulated between boron nitrides (Fig. 1A). When heated to ~200°C, Pd ions transport outwards (Fig. 1B, D, E) and react chemically with the TMD film to form a new crystalline compound $Pd_xWTe_2$ (x~7) that displays superconductivity below 1 K (Fig. 1C).
- The results demonstrated an unexpected, previously unexplored region of 2D chemistry. It is generalizable to other combinations of materials.
- The approach introduces a new route for fabricating high quality, sub-micron-sized superconducting devices based on topological chalcogenides and moiré materials.
- The MRSEC team has fabricated superconducting junctions on twisted bilayers of $MoTe_2$. One of the goals is the proximitization of exotic quantum states, e.g. the Fractional Chern Insulator.

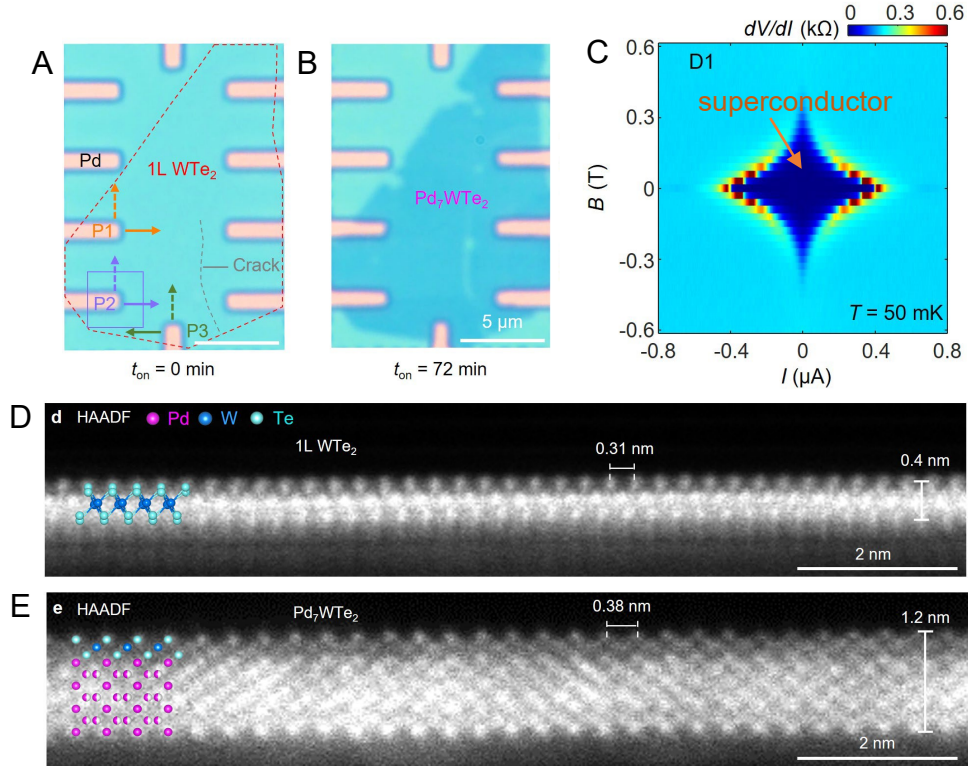


Fig. 1. (A) Pd electrodes (pink) deposited on hBN film (blue) in contact with $WTe_2$ (dashed outline) before heating. (B) Heating leads to formation of an ultrathin layer of $Pd_7WTe_2$ (dark blue). (C) Color map of *dV/dI* of a $Pd_7WTe_2$ superconductor. (D) Dark-field image of pristine monolayer $WTe_2$. (E) Image after formation of $Pd_7WTe_2$.

Y. Jia*, F. Yuan*, G. Cheng, Y. Tang, G. Yu, T. Song, P. Wang, R. Singha, A. J. Uzan, M. Onyszczak, K. Watanabe, T. Taniguchi, N. Yao, **L. M. Schoop**, **S. Wu**, "Surface-Confined Two-Dimensional Mass Transport and Crystal Growth on a Monolayer," ***Nature Synthesis*** (2023) https://doi.org/10.1038/s44160-023-00442-z