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Enhanced superconductivity in atomically thin 2H-TaS_2 down to the ultra-thin limit[1] YAFANG YANG, EFREN NAVARRO-MORATALLA, Massachusetts Institute of Technology, KENJI WATANABE, TAKASHI TANIGUCHI, National Institute for Materials Science, Japan, PABLO JARILLO-HERRERO, Massachusetts Institute of Technology — One attractive candidate for realizing superconductivity in the 2D limit is transitional metal dichalcogenides (TMDs). For example, studies of $NbSe_2$ have verified superconductivity down to monolayer, with T_c reduced from 7 K (bulk) to 3 K (monolayer). Similar to $NbSe_2$, 2H-TaS_2 is another candidate, with very similar crystal structure yet T_c less than 1 K in bulk. Prior work attempting to access the 2D limit of 2H-TaS_2 has found significant sample degradation after fabrication, and it turns to insulating behavior when thickness is less than 3.5 nm. We are able to overcome it by encapsulating TaS_2 flake with hBN in a glove box while also using thin pre-evaporated metal contacts to maintain a good van der Waals 'seal' to prevent air from reacting with the sample. With this method, we find that superconductivity persists down to the bilayer limit. More surprisingly, we observed pronounced increase in the T_c from around 0.7 K (bulk) to 3 K (bilayer) when the thickness of the flake is reduced, opposite to the trend observed in most superconducting films as well as recent studies on $NbSe_2$. This provides interesting evidence that reducing the dimensionality can actually strengthen superconductivity as opposed to the weakening effect that has been reported in other 2D materials.

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