Wafer scalable single-layer amorphous MoO_3

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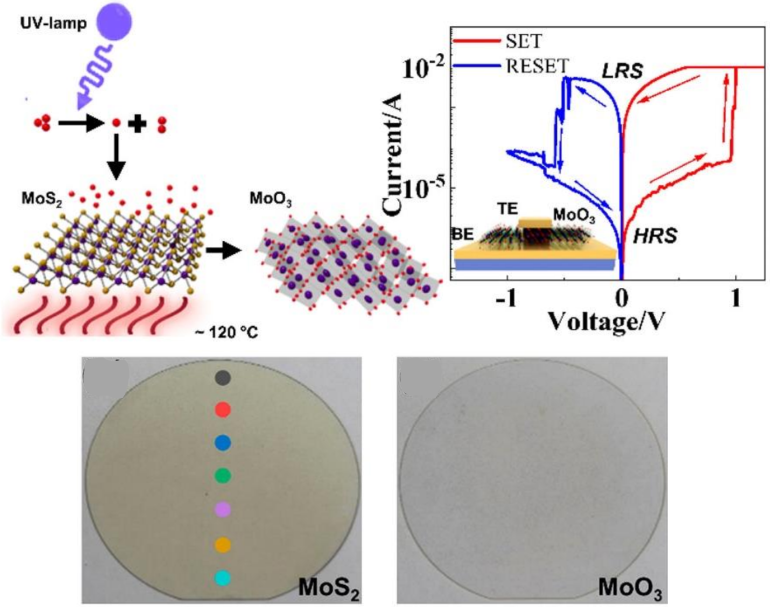
Project Summary: Molybdenum trioxide (α-MoO_3) is a wide bandgap 2D layered oxide (E_g~3 eV) that is of interest for resistive switching-based nonvolatile memory devices. It is difficult to produce large-area monolayer MoO_3 through exfoliation of bulk crystals or other techniques. This study demonstrates a facile route to obtain wafer-scale monolayer amorphous MoO_3 using monolayer 2D MoS_2 grown by metalorganic chemical vapor deposition (MOCVD) as a starting material, following by UV-ozone oxidate at substrate temperatures as low as 120^{o}C. The process yields smooth, continuous, uniform and stable monolayer oxide with wafer-scale homogeneity. Using the subnanometer MoO_3 as the active layer sandwiched between two metal electrodes, we demonstrate the thinnest oxide-based nonvolatile resistive switching memory with low voltage operation and high ON/OFF ratio. These results, which are potentially extendable to other transition metal oxides, will enable further exploration of subnanometer stoichiometric MoO_3, extending the frontiers of ultrathin flexible oxide materials and devices. Published in *ACS Nano* (2022), available online at: https://doi.org/10.1021/acsnano.1c07705

2DCC Role: The wafer-scale monolayer MoS_2 used as the starting material in this study was produced by MOCVD in the 2DCC-MIP facility.



A low temperature UV/ozone process was developed to convert wafer-scale 2D MoS_2 to monolayer amorphous MoO_3. The large area MoO_3 was used to demonstrate ultra-thin oxide-based resistive switching devices with low voltage operation and high ON/OFF ratio.