SUPPLEMENTAL MATERIAL

To accurately determine the sputter rate for the target oxide system, we performed additional calibration using a Dektak XT profilometer (Bruker). The detailed process is: A reference oxide sample (Al_2O_3) was used, whose thickness was pre-calibrated to be 10–50 nm with an uncertainty of ±0.3 nm. We strictly adopted the same conditions as in the XPS depth profilin to avoid rate deviations from parameter variations. The reference sample was sputtered for different durations (5 s, 10 s, 20 s, 30 s, 50 s), and the thickness difference before and after sputtering was measured by the profilometer. A linear calibration curve (sputtering time vs. removed thickness) was plotted. With a fitting R^2 of 0.997, the sputter rate for the target oxide was determined to be 0.098 nm/s ± 0.005 nm/s. This is consistent with the initially assumed "10 s = 1 nm" (0.1 nm/s) with a deviation of < 2%, which falls within the acceptable experimental error range.

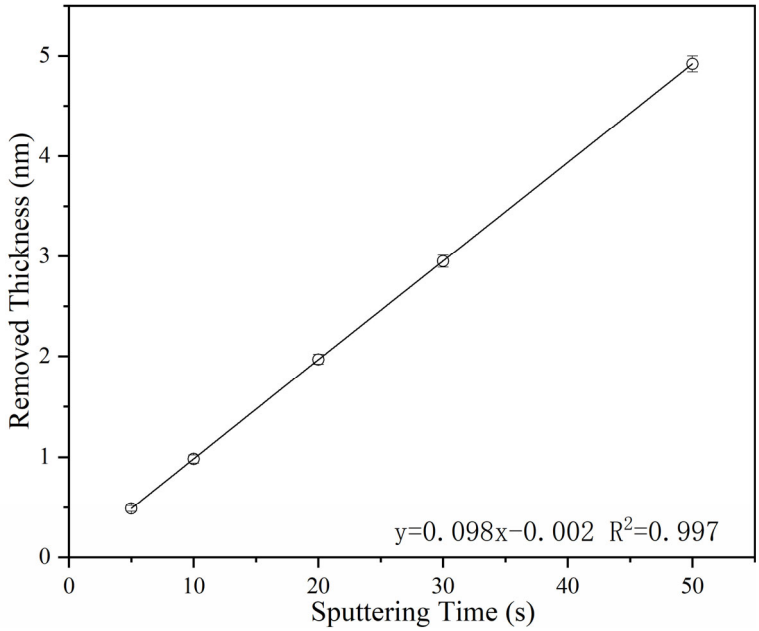


Figure S1. The Calibration Curve of Ar Sputter Rate for Target Oxide System