Sacrificial Etching Kinetics Control Extent of Pattern Alignment in Area-Selective Atomic Layer Deposition (AS-ALD) via Simultaneous Deposition and Etching

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Session – AS3: Inherently Selective Processes

Supplemental Document

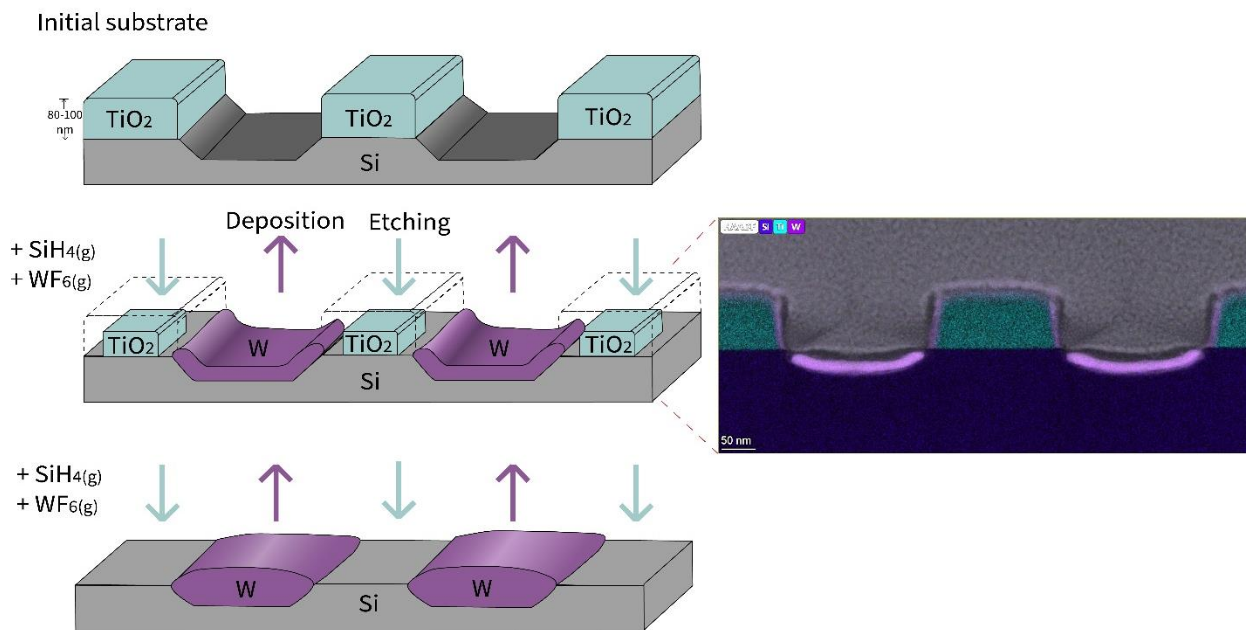

Figure 1: Schematic of W ASD mechanism. The initial substrate consists of 80-100 nm thick TiO_2 lines on Si. W preferentially nucleates on Si by sequentially dosing SiH_4 and WF_6 gases from 220-280°C. $WF_{6(g)}$ etches TiO_2 features by volatile fluorination within the same temperature range. Therefore, when we combine a deposition process with an etching process, the sacrificial feature consumes the deposition precursor that would have led to parasitic W nucleation—shown in the middle schematic and STEM-EDS map. Ideally, repeating this process will etch away the remaining TiO_2, resulting in selectively deposited W lines on Si.

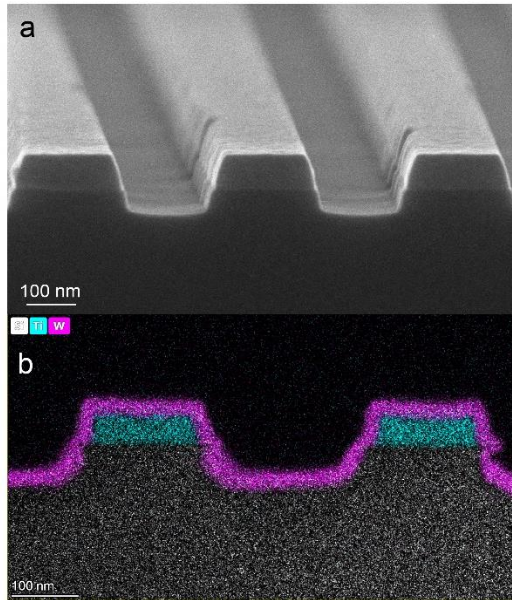

Figure 2: SEM images of (a) starting substrate, (b) STEM-EDS map of 10 ASD cycles at 280°C resulting in non-selective W ALD with Si substrate etching. In this case, TiO_2 etches non-conformally and forms a mixed oxyfluoride layer of W and Ti. This porous layer allows for parasitic W growth.