<u>Supplemental Section</u>

Self-limiting Thermal Atomic Layer Etching of Tungsten Metal Using O_2 Oxidation and WCl_6 or WF_6: Role of Halogen Species in Temperature Dependence of ALE Reaction Rate

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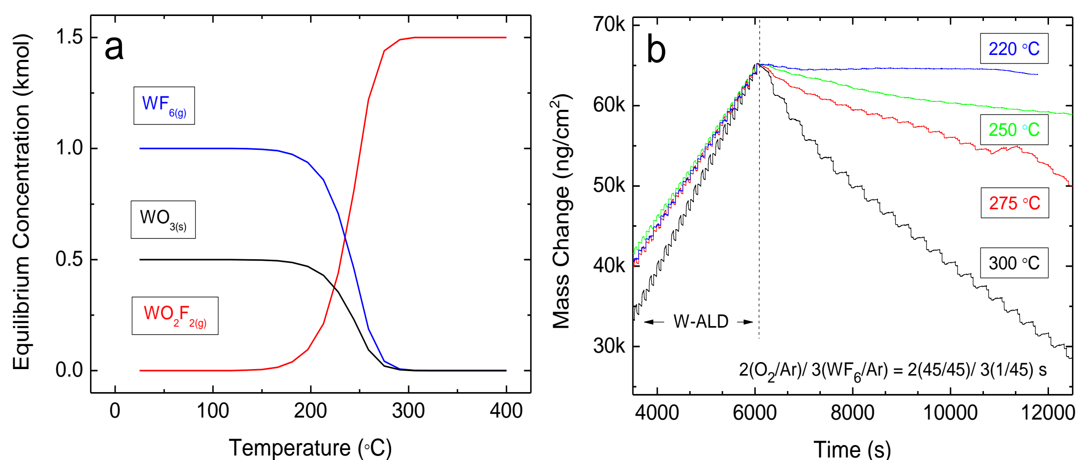

Figure 1. (a) Thermodynamic modeling results showing the expected equilibrium species and concentrations from 25 to 400 °C for a closed system at 1.5 Torr, initially consisted of 0.5 mol WO_3 and 1.0 mol of WF_6. (b) QCM analysis of W ALD followed by W etching using O_2 and WF_6 at temperatures between 300 to 220 °C.

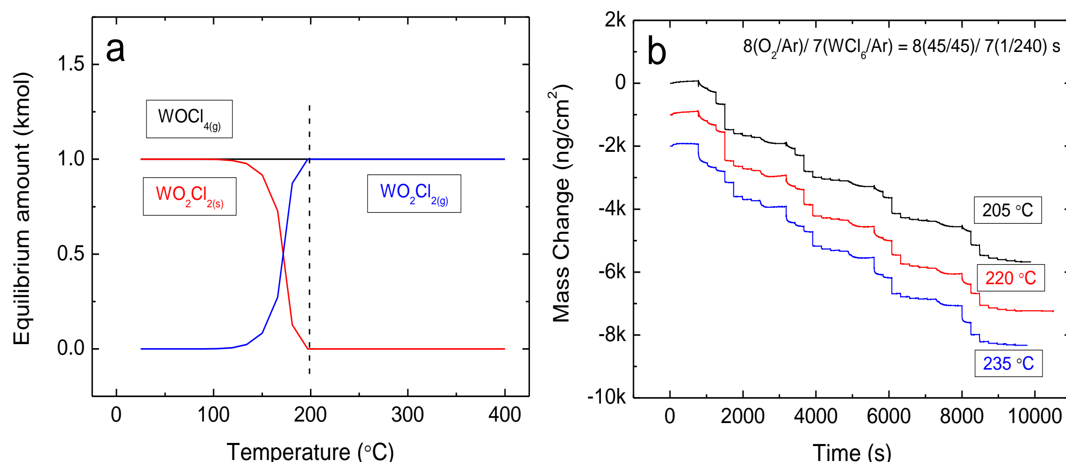

Figure 2. (a) Thermodynamic modeling results showing the expected equilibrium species and concentrations from 25 to 400 °C for a closed system at 1.5 Torr, initially consisted of 1.0 mol WO_3 and 1.0 mol of WCl_6. (b) QCM analysis of W etching using O_2 and WCl_6 at temperatures between 205 to 235 °C.