(Supplemental)

In-situ Surface Cleaning and Area Selective Deposition of SiO_xN_y film on Cu using Anhydrous N_2H_4

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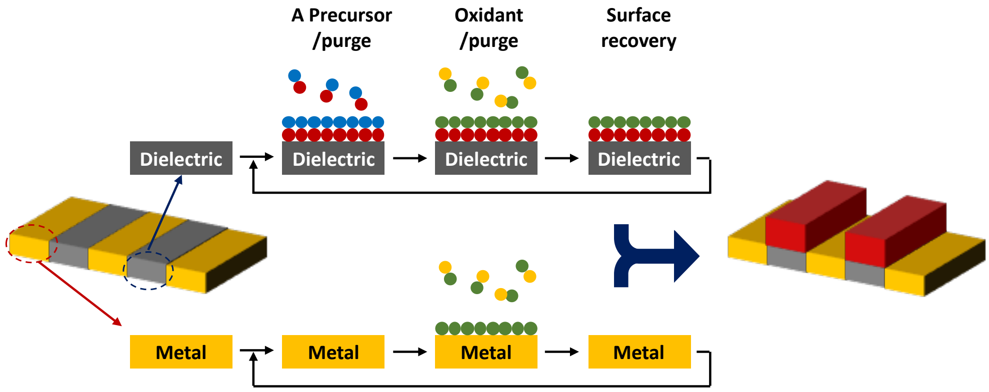

Figure 1. Schematic illustration of ideal AS-ALD of dielectric-on-dielectric patterns using ABC-type ALD cycle with surface cleaning agent. 'A' precursor can be only adsorbed in the dielectric area, whereas co-reactant ('B' precursor) can oxidize both of adsorbed precursor and the clean metal surface. Subsequently, with the introduction of N_2H_4 ('C' purecursor), the oxidized metal surface can be recovered to the initial metallic surface without changing the surface condition of the dielectric area.

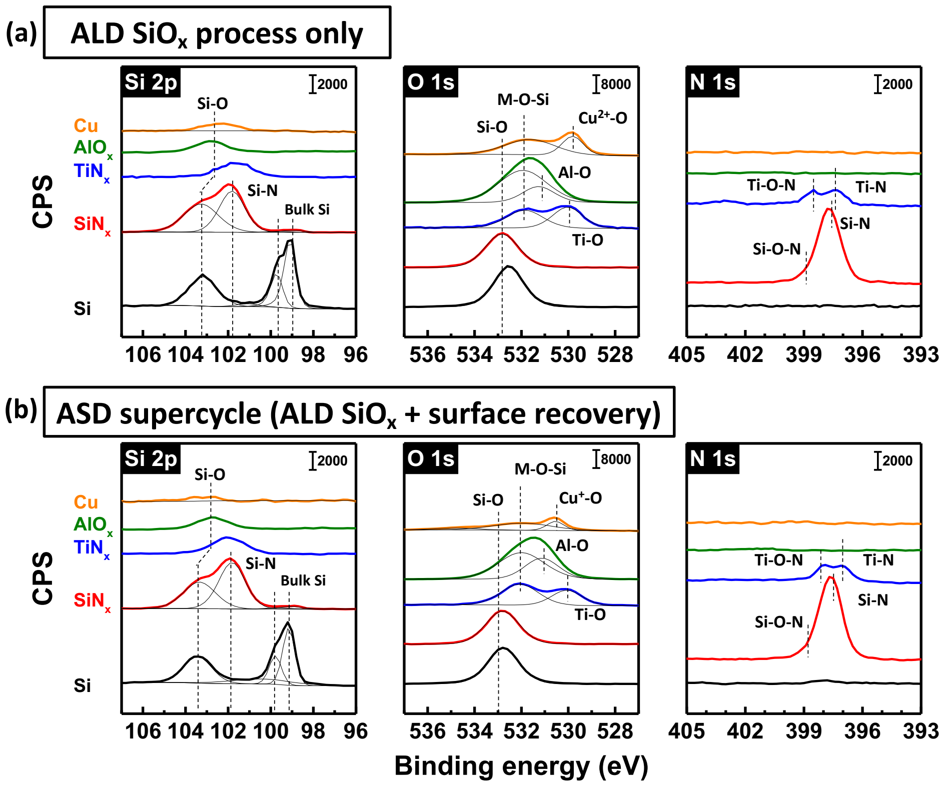

Figure 2. XPS spectra of Si 2p, O 1s, and O 1s on different substrates after 5 cycles of (a) ALD SiO_x only and (b) ABC-type ALD of SiO_x. With five supercycle ALD-SiO_x processes, the unchanged growth of SiO_2 on both bare Si and SiN_x substrates, formation of metal-silicates (and/or SiO_x) on TiN_x and AlO_x suggest that the supercycle-based ALD-SiO_x process does not impact the growth of SiO_x on top of dielectric substrates. On the other hand, the deposited amount of SiO_x on Cu substrate is approximately 35% less than the previous ALD-SiO_x process. Furthermore, the formation of Cu_2O (530.4 eV) rather than CuO (529.6 eV) suggests that N_2H_4 slightly inhibited the oxidation of the Cu surface. In N 1s narrow scan, nitridation of the Cu surface by N_2H_4 is not observed, indicating that most of the introduced N_2H_4 molecules were used to reduce surface oxide without any formation of Cu-N bond.