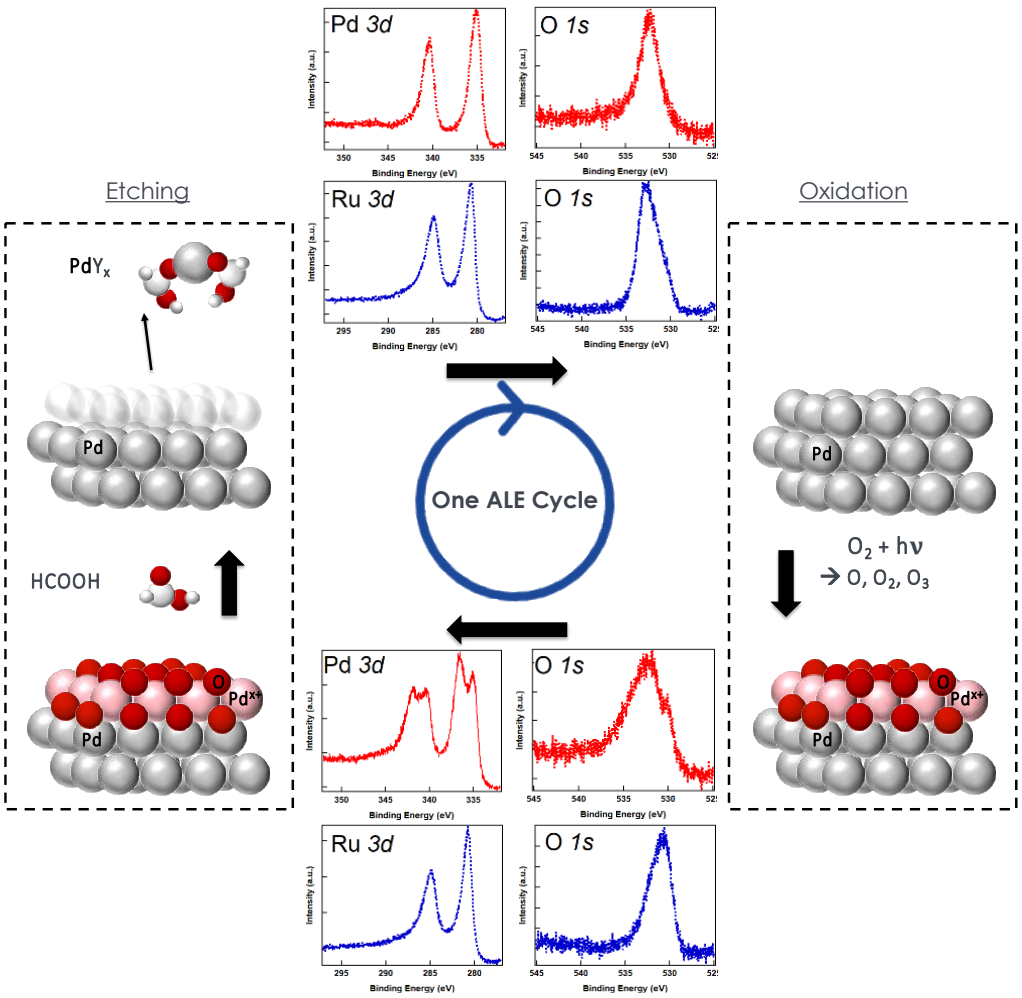

Figure 1. A schematic for VUV enhanced ALE is shown, where one ALE unit cycle consists of an etching and oxidation half cycle, shown on the left, and right, respectively. In the oxidation half cycle, metal, M is co-exposed to O_2 and light, hν, which produces O and O_3. These oxidants oxidize the metal surface to metal oxides, M^+. In the subsequent etching cycle, HCOOH vapor is introduced to adsorb and remove the metal oxide layer. The surface then returns to its starting state for more ALE cycles. Pd 3*d*, O 1*s* and Ru 3*d* XP spectra are shown for Pd and Ru thin film during an ALE cycle.

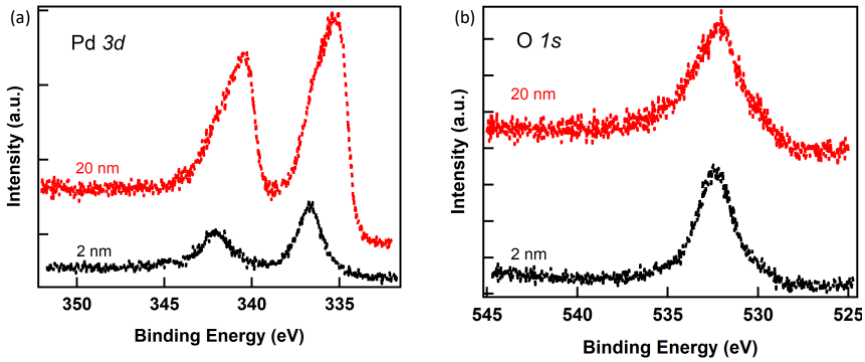

Figure 2. Pd 3*d* and O 1*s* XP spectra for 20 nm (red) and 2 nm Pd (black) after being co-exposed at 100 °C to 1 Torr O_2 and VUV light for 3 min and 1 min, respectively.