Thermally Activated Atomic Layer Annealing (ALA): A Plasma Free Approach to Densification of Hafnia Thin Films

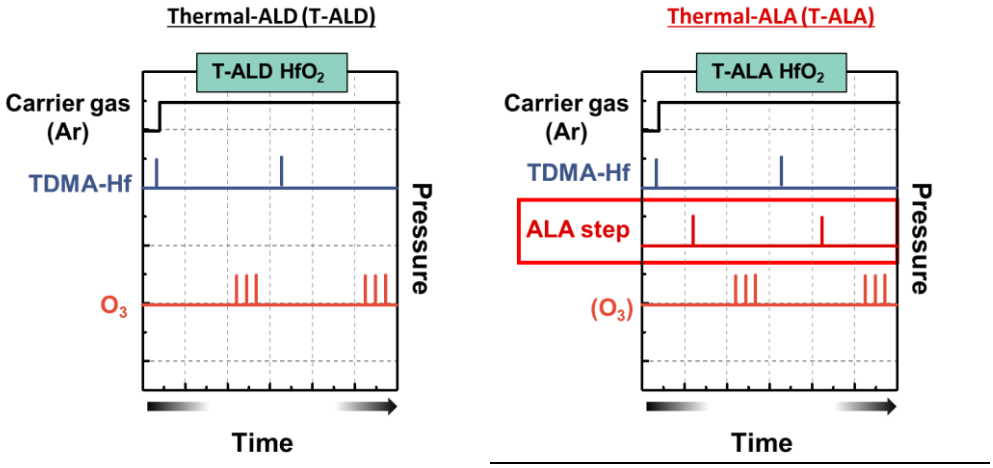

Fig 1. Pulse schematics of Thermal-ALD and Thermal-ALA processes. Thermal-ALA process adds an additional chemical annealing step followed by O_3 pulses to densify and oxidize the metal precursor

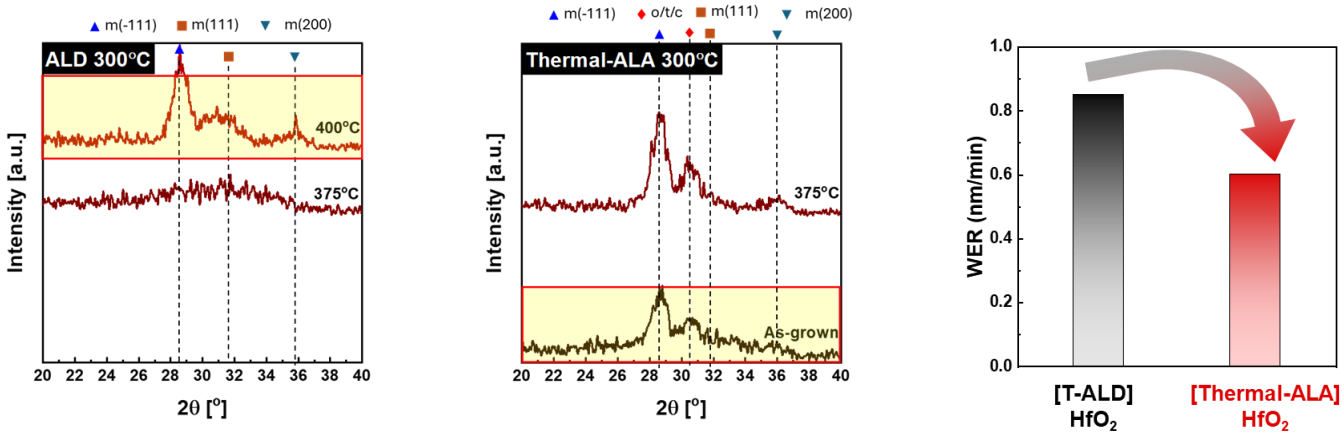

Fig 2. X-Ray Diffraction (XRD) measurements after \post deposition annealing (PDA) and wet-etch rate comparison between thermal-ALD and thermal-ALA hafnia thin films deposited at 300°C. Thermal-ALA films deposited at 300ºC are crystalline as deposited, while conventional ALD films require PDA of up to 400ºC before crystallization. Thermal-ALA also results in a denser film that exhibits increased resistance to wet etchants (100:1 HF).