

Supplemental material

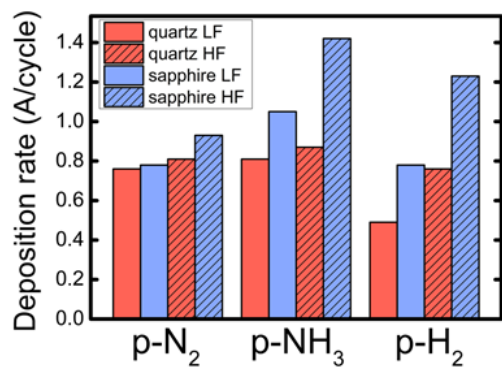


FIG. 1. Deposition rates obtained for the TiN PEALD processes using either low (painted columns) or high (painted and hatched columns) flow of various reactive gases.

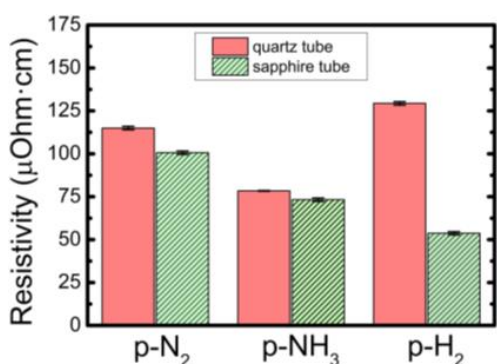


FIG. 5. Resistivity of TiN films (~30 nm) deposited using various reactive gases at the low flow.

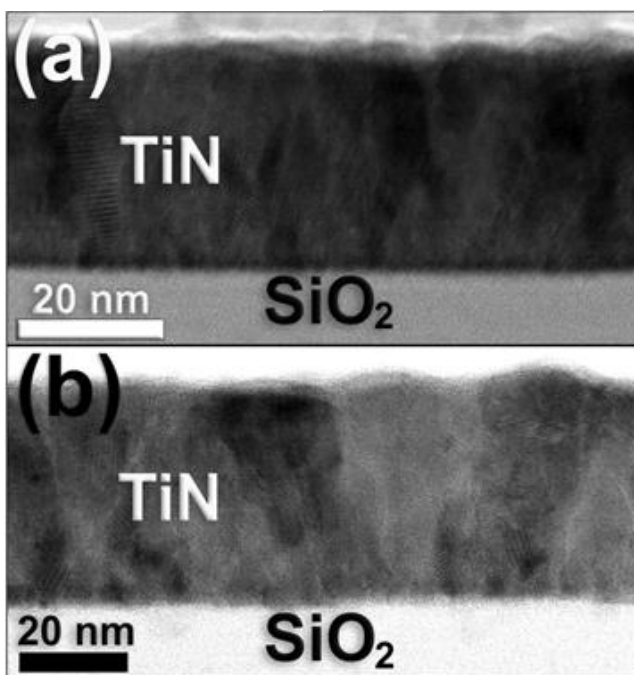


FIG. 4. Bright-field STEM micrographs of TiN PEALD films deposited using a hydrogen plasma at the (a) quartz or (b) sapphire tube equipped ICP system. The films were deposited at the low flow mode.

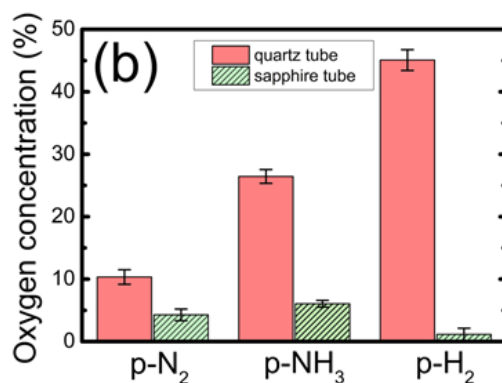
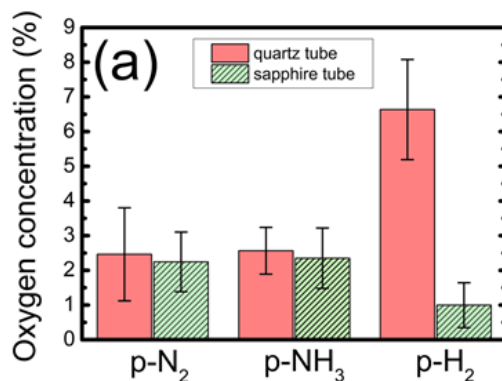


FIG. 2. Oxygen concentration determined by XPS depth profiling in the TiN films (~30 nm) deposited using either (a) low or (b) high flow of various reactive gases.

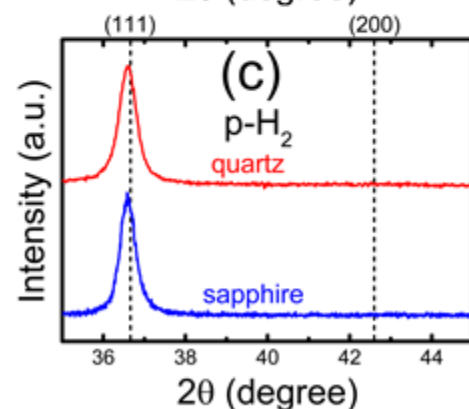
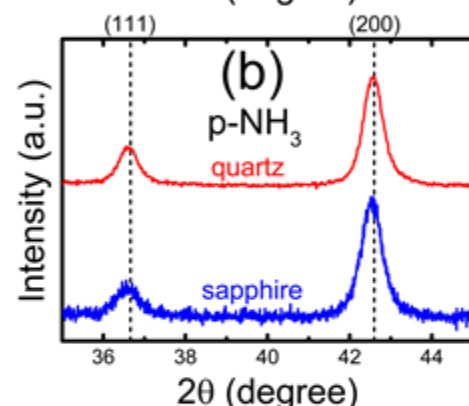
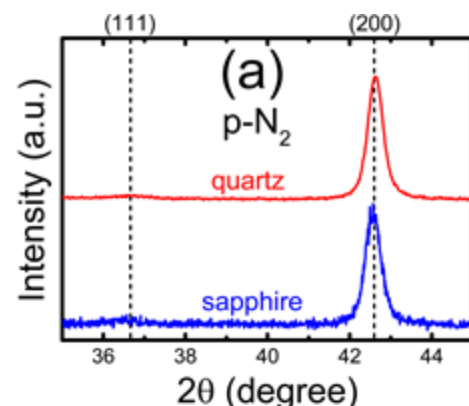


FIG. 3. $\theta/2\theta$ XRD measurements of TiN PEALD films (~30 nm) deposited using (a) nitrogen, (b) ammonia, and (c) hydrogen plasma at the low flow mode.

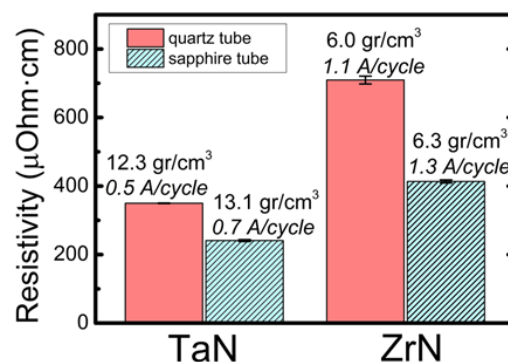


FIG. 6. Resistivity of TaN and ZrN films (~30 nm) deposited using a hydrogen plasma at the low flow mode. The deposition rates and film densities are also noted.