LOW TEMPERATURE PLASMA-ENHANCED ATOMIC LAYER DEPOSITION OF METAL OXIDE THIN FILMS

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Atomic layer deposition (ALD) processes have a temperature window governed by the reactivity and stability of the precursors and the surface groups involved in precursor adsorption. Few processes have been reported at considerably low temperatures, which are a necessity for temperature-sensitive substrates, such as polymers[1,2] or metals,[3] the mechanical properties of which may be altered by higher temperatures. Although films grown at lower temperatures generally contain more impurities, plasma-enhanced ALD may reduce these.[4] As such, this project aims to develop and optimise the plasma-enhanced ALD of Al_2O_3, TiO_2 and Ta_2O_5 at 25-250 °C as an alternative to thermal processes.

The precursors were $[AlMe_3]$, $[Ti(O^iPr)_4]$, $[Ti(Cp^{Me})(O^iPr)_3]$ and $[Ta(NMe_2)_5]$ respectively and an O_2 plasma was employed as the oxygen source. The substrate temperature had a notable effect on the growth per cycle for $[AlMe_3]$ (Fig. 1), which was reduced with increasing temperature. However, the growth per cycle values remained almost constant for the titanium and tantalum systems. For Al_2O_3, the [O]/[Al] ratio was always higher than the desired 1.5 at temperatures below 200 °C. Hydrogen was the most significant impurity, which was reduced by higher substrate temperatures. For TiO_2 and Ta_2O_5 the [O]/[Ti] and [O]/[Ta] ratios were more consistent at 2.0 and 2.5 respectively although hydrogen concentrations of ~5 at.% were present in both cases.

This presentation assesses whether plasma-enhanced ALD can produce films of sufficient quality for the desired applications[1-3] and how the films compare with those deposited by thermal ALD at similar temperatures.

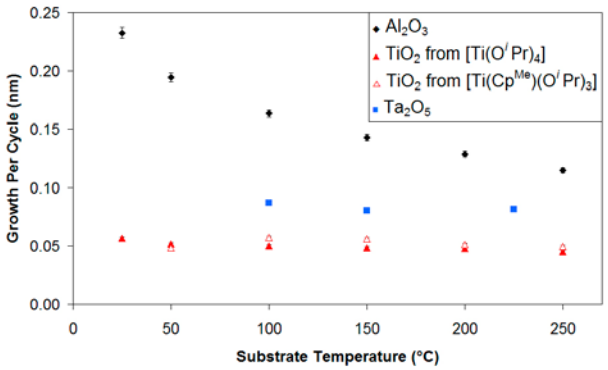

Figure 1. Variation of growth per cycle with substrate temperature.

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3. R. Matero *et al.*, *J. Phys. IV*, **9**, Pr8: 493 (1999).
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