Surface and interface engineering of TiO_2 thin films deposited on carbon nanotubes by Atomic Layer Deposition

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In this work we studied the nucleation and growth mechanisms of ALD TiO_2 on vertically aligned carbon nanotubes (CNTs) using TTIP and H_2O. The use of CNTs as a model substrate to deposit metal oxides offers several advantages to study the interface, nucleation and growth of ultrathin films compared to the traditional flat substrates. The versatility of CNTs to be dispersed on a TEM grid allows for direct observation of the nucleation density, thickness, and morphology of the TiO_2 film [1]. The large surface area of the CNTs and thus of the deposited metal oxide, greatly enhances the signal of many characterization methods (i.e. Raman, XPS, XRD) to study crystallization, stresses, chemical bonding and oxidation states even with only ~1-nm-thick film. Additionally, we can monitor the sp^2-to-sp^3 transition of the surface carbon atoms as a function of the number of cycles to elucidate surface coverage [2]. These studies have revealed a temperature dependence in the nucleation density (surface coverage), which consequently influences the growth behaviour and surface characteristics. We will present this work and discuss the approach of using nanostructures as a model substrate to study thin films deposited by ALD.

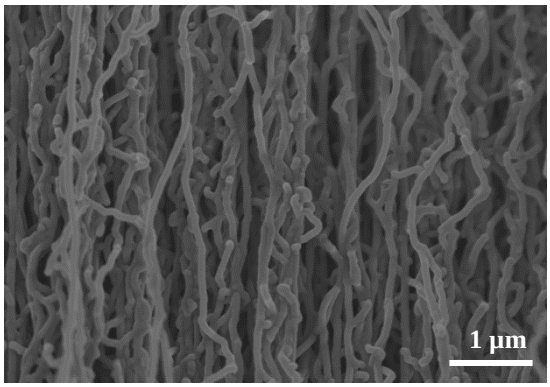

Figure 1. SEM image of vertically aligned carbon nanotubes conformally coated with 10 nm of TiO_2.

References

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