Title: Surface engineering of surfaces using polymer brushes

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Abstract
Thin film deposition is a critical fabrication in a host of sectors spanning electronics, medical devices, construction and bioassay. The thin films add function to an inert substrate and so define the properties of these. However, making thin films (<50 nm) can be challenging in terms of achieving regular thickness, high coverage, controlled density and defect free. The compositions that can be achieved are limited by methods such as atomic layer deposition. The materials may also afford problems because of their refractory nature, availability and cost of film precursors and issues such as thermal/mechanical mismatch with the substrate. Thermal evaporation, sputtering, plasma deposition and chemical vapour deposition have been developed as suitable coating techniques but require capital intensive equipment.

In this work we have developed a wet chemical approach. We use polymer brushes (i.e. macromonomers with end groups which can chemically bind to a chosen substrate) as a template for film development. Typical examples would be hydroxy terminated poly methyl methacrylate or polystyrene vinyl pyridine . The chemical bonding allows us to fabricate a brush layer of high coverage and highly uniform thickness. The film is then exposed to a solution of metal salt where the solvent swells the polymer brush layer. This infiltrates metal cations into the film. A subsequent oxidation process removes polymer whilst oxidizing cations to the oxide forming a dense film. Typical examples include Al_2O_3 and TiO_2 but complex tertiary oxides and metals can also be processed such as indium-tin oxides. The process is capital and energy inexpensive. Further, the technique can be used to coat complex shapes including interior volumes. Applications of these films will be illustrated and discussed. Comparison to competing coating methods will be made by comparison of morphology and electrical properties.