# Improving the adhesion of sputtered metal coatings on PMMA using an ALD interlayer.

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## Abstract

Magnetron sputtered metal and metal compound films generally show very poor adhesion to polymethylmethacrylate (PMMA) which limits the use of the polymer for components which are wear or scratch resistant or have a decorative finish. Plasmas can have a complex effect on the PMMA; it can have a degrading effect on the PMMA molecules but can also be employed to enhance the adhesion under certain circumstances. We have shown that adhesion can be significantly improved by a duplex process where an adhesion layer of $TiO_2$ or $Al_2O_3$ with a thickness of tens of nm is deposited by low temperature atomic layer deposition (ALD) followed by deposition of the metal layer using pulsed DC reactive magnetron sputtering. The adhesive strength of the metal films on the PMMA substrate was measured using the pull-off adhesion test. With the presence of the ALD adhesion layer, the pull-off adhesion strength increased to the point where the failure mechanism was due to cohesive disruption of the substrate material itself rather than an interfacial failure. The changes in the bonding structure at the surface of the polymer as a function of the plasma exposure and the film deposition have shown that the ALD deposited layers protect the PMMA against plasma damage during the sputtering process by blocking both direct ion damage and also disruption of the polymer structure by short wavelength ultra-violet radiation absorption.