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Low temperature deposition of crystalline photocatalytic TiO2 thin films onto polymeric web

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A high temperature of formation is normally required for the growth of photocatalytic titanium dioxide thin films in order to produce the correct crystalline phase. This has two disadvantages - it limits the choice of substrate material available for use, and may preclude deposition onto existing layers in multilayer functional devices that may suffer thermal or inter-layer diffusion damage. A commonly used technique for industrial thin film production is magnetron sputtering, which is highly versatile, scalable and produces high-quality thin film materials. A novel variant of this technology can provide the energy input sufficient to promote crystalline growth without excessive substrate heating, by the use of High Power Impulse Magnetron Sputtering (HiPIMS). This technology produces a deposition flux with a high degree of ionisation, providing significant amounts of energy to the condensate due to recombination with electrons, but without delivering large thermal loads to the underlying substrate. Hence, the range of applications that are available for the exploitation of titania photo-catalysts can be significantly expanded.

A wide process envelope has been investigated in order to identify conditions for optimised growth on a range of substrate materials, in terms of crystallinity, temperature and deposition rate. The resulting coatings were analysed via XRD, Raman Spectroscopy, SEM, TEM, contact angle analysis and surface profilometry. The deposition process is characterised in terms of the plasma conditions, deposition rate and thermal probe measurements. The characterisation of photocatalytic properties of the coatings is by dye degradation test, with comparison made to a commercially produced photocatalytic material.

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