Zinc Oxide Thin Films Deposited by Plasma-Enhanced Atomic Layer Deposition for Accelerated Microplastic Degradation

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Abstract

The deposition of thin zinc oxide (ZnO) on thermally sensitive substrates, such as polymers, is a major challenge due to the risk of substrate damage at elevated temperatures. Plasma-enhanced atomic layer deposition (PEALD) is a suitable solution that enables synthesis at room temperature [1]. In contrast to conventional ALD, which tends to produce lower-quality films at temperatures close to room temperature, PEALD uses oxygen plasma to achieve polycrystalline ZnO films with excellent photocatalytic properties [2]. For example, films deposited with a plasma RF power of ≥200 W exhibit nanocrystalline structures and significantly higher photocatalytic activity than amorphous films produced with a lower power. Thin ZnO films are applied to microplastics to accelerate their degradation when exposed to light. The photocatalytic mechanism is that UV light generates electron-hole pairs in ZnO that form hydroxyl (•OH) and superoxide ($O_2^{\bullet-}$) radicals. These radicals oxidise the polymer chains, which leads to a roughening of the surface and ultimately to the decomposition of the microplastic in an aqueous environment [3].

In this seminar, I will present our recent results on PEALD synthesis and characterization of ZnO thin films and their application in photodegradation of plastic microfibres.

Keywords: photocatalysis, thin films, plasma-enhanced atomic layer deposition, zinc oxide

References:

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