Investigating the effect of UV exposure on fluoropolymers

Background

Polymers are a versatile and valuable category of materials, their properties often manipulated by varying their composition and molecular weight. As nanoscience and nanotechnology become increasingly important, the use of polymeric thin films is rapidly increasing also. The ability to use thin polymer films to change the surface or interfacial properties of a material is well established. Fluoropolymer thin films can be deposited onto a variety of surfaces using plasma-enhanced chemical vapour deposition. This imparts a change in the wettability of the surface, the fluoropolymer being hydrophobic in nature. However, the durability of these films remains an issue under close scrutiny [1], with both chemical and mechanical effects likely to be detrimental to the film under certain conditions.

Objective

Expose a fluoropolymer thin film to 254 nm wavelength UV radiation, under an inert atmosphere.

Experimental

Using a custom-built irradiation chamber [**Figure 1**], it was possible to expose fluoropolymer thin films to 254 nm UV radiation in the presence or absence of atmospheric O_2. The quartz windows permitted high efficiency transmission of the 254 nm UV, whereas borosilicate glass would have significantly attenuated the transmission. Film thicknesses were measured using a UVISEL ellipsometer (Horiba Scientific, UK), while surface topography was characterised using a NanoWizard II atomic force microscope (AFM, JPK Instruments, UK).

Results

The surface topography of the fluoropolymer film is shown in **Figure 2**. Following exposure to 254 nm UV radiation there was a measurable decrease in film thickness, when the surrounding medium contained O_2. When the atmosphere was composed of pure N_2 however, there was no decrease in film thickness.

Figure 1. Custom-built UV irradiation chamber with CaF_2 windows, suitable for inert atmospheres

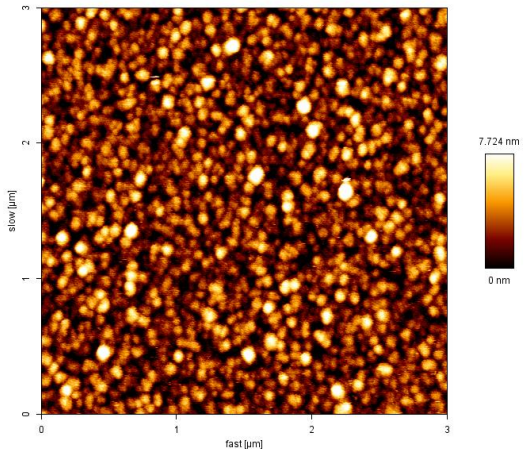

Figure 2. AFM image of fluoropolymer thin film following exposure to 254 nm UV radiation for 21 h

References

1. Cheneler, D..; Bowen, J.; Evans, S.D.; Górzny, M.; Adams, M.J.; Ward, M.C.L.; Characteristics and durability of fluoropolymer thin films, *Polym. Degrad. Stabil.*, **2011**, *96*, 561-565.

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