OR0302

Plasma etching of transparent polymers: tailoring surface nano-topography for low reflectivity and extreme wetting

Rosa Di Mundo[1], Fabio Palumbo[2], Mariagrazia Troia[1], Massimo Trotta[3], Riccardo d'Agostino[1]

[1]University of Bari, Bari, Italy [2]CNR-IMIP, Bari, Italy [3]IPCF, Bari, Italy

rosadimundo@chimica.uniba.it

Low reflective transparent polymers are required for applications in optics, automotive, energetics. Properly configured and distributed surface nano-features, with mixing air and solid medium on a sub-wavelength scale, can reduce light reflectance according to the so-called moth-eye effect. Such nanostructured layers are under study as alternatives to conventional interference coatings, but the method of nanotexturation is still critical. We have already shown that plasma etching of various polymers in oxygen and/or fluorinated feeds in reactive ion etching configuration leads to a highly tunable nanotexture, with interesting wetting effects.
In this contribution we show that plasma nanotexturing of transparent polymers, such as polycarbonate and polystyrene, if properly tailored, can result in reflectance abatement up to 40% in a simple single step process. In particular, we have investigated the role of topographical features in the light trapping phenomenon by characterizing differently textured surfaces from different plasma conditions with scanning electron microscopy and reflectance (specular and diffuse) measurements .
We have found that, while treatment duration or input power affect both height and distance among structures, it is possible to selectively increase features height by playing with the O_2-to-CF_4 ratio in plasma feed, or by conducting a pre-deposition in the same batch of a ultra-thin organic film (PDMS-like or TEFLON-like). Tall and narrow structures in fact, in agreement with theory, allow to avoid diffusive losses and reach a pronounced and broad band moth-eye effect.
We also show that multi-functional surfaces can be this way addressed: provided the outer chemistry is controlled, extreme wetting properties (slippery superhydrophobic and stable superhydrophilic) can be joined to low reflectance since similar topographical features are required.

Keywords
etching
nanotexture
polymer
reflectivity
wetting