Preparation of self-cleaning AG/AR film with hollow structured layer of titania particles.

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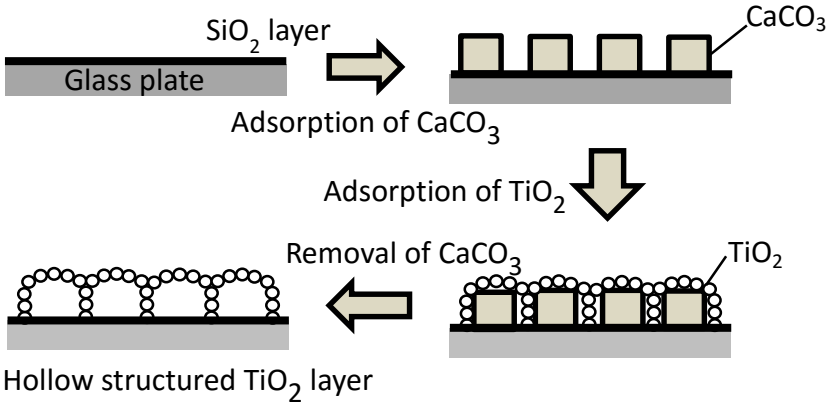
Anti-reflection or anti-glare films are widely used in order to improve the visibility of displays. Among the several ways for achieving the AG/AR properties,[1] preparation of air-containing layer on the top of substrate to make lower refractive index compared with the substrate material is effective to prepare a film with gradation of refractive index on the top of the substance. To achieve such structure, we attempted to prepare hollow structure on the glass slide. And TiO_2 nanoparticles were employed as building blocks of the film to endow the photo induced self-cleaning activity.[2]

A glass substrate with silica layer was hydrophilized by alternative adsorption of oppositely charged linear polymers (Layer-by-Layer method). Cubic submicron calcite particles were casted onto the glass substrate by dip coating method. Then Layer-by-Layer deposition of charged polymers was applied to the glass substrate again. The positively charged glass was immersed into the titania nanoparticle dispersion. Then the glass plate heated to fuse the surface of titania particles to connect each other and fix their location. Polymer molecules were burnt out during this process. The glass slide with calcite / titania film was immersed in hydrochloric acid to remove calcite. Finally the glass with titania film was calcined again and obtain hollow titania coated glass. The obtained film was observed by FE-SEM, and analyzed by EDX. Optical property was evaluated by UV-vis absorption spectroscopy. And the self-cleaning properties were evaluated by contact angle recovery of the oleic acid and heptanes casted surface.

Many voids were seen in the titania particles accumulated layer. Transmittance of visible light was increased for the hollow structured titania film compared to those of glass substrate surface or the dense titania surface of film on the glass substrate. And the water contact angle of the oil wetted surface was rapidly decreased by irradiation of UV light.



Scheme : Preparation of hollow structured TiO_2 layer on top of glass substrate with calcium carbonate template.

References

[1] Raut et al., Energy & Environmental Science (2011), 4(10), 3779-3804.
[2] Fujishima et al., Surface Science Reports (2008), 63(12), 515-582.