論 文 の 要 旨

題 目 Atmospheric-Pressure Plasma-Enhanced Chemical Vapor Deposition for the Fabrication of TiO_2 UV-Protective Thin-Film

(大気圧プラズマ CVD による UV 遮蔽 TiO_2 薄膜の開発)

氏名 XU JING

The overall objective of this research in doctoral education is to study the fabrication of TiO_2 UV-protective thin-film by atmospheric-pressure plasma-enhanced chemical vapor deposition (AP-PECVD) method.

Chapter 1 is "**Introduction**", which introduced the atmospheric pressure plasma, atmospheric-pressure plasma-enhanced chemical vapor deposition, and UV-protection, and presented the objective of this study.

Chapter 2 is "**Improving the UV-protective performance of AP-PECVD-derived TiO_2 thin-film**". This chapter focused on control of film thickness and roughness to improve the UV-protective performance of TiO_2 films prepared via AP-PECVD. The relationship between the film morphology and UV-protective performance suggested that a decrease in roughness is the key factor to achieve performance improvement. The effects of substrate temperature and precursor concentration were investigated, and the results showed that an increase in both substrate temperature and precursor concentration reduced the roughness and improved the transparency to visible light without reducing the ability to block UV light. Finally, a TiO_2 film with greater than 99 % UV light blockage and greater than 95 % transmittance of visible light was obtained.

Chapter 3 is "**TiO_2-coated polymers and the stability against UV irradiation**". The aim of this chapter was to improve the stability of polymers against UV irradiation through coating TiO_2 films using AP-PECVD method. TiO_2 films with granular morphology and good adhesion were coated on polymethylmethacrylate (PMMA) and polycarbonate (PC) via AP-PECVD successfully. After coating the TiO_2 films, the transmittance of PMMA and PC decreased dramatically in the UV light region and remained at a high level in the visible light region. Finally, the degradation of PMMA and PC under UV irradiation markedly slowed down after coating with TiO_2 films, which indicated that TiO_2-coated polymers show significantly improved stability against UV irradiation.

Chapter 4 is "**Fabrication of large-area TiO_2 UV-protective thin-film**". In actual production process, continuous fabrication and coating of large-area TiO_2 UV-protective film are needed. To solve this problem, generally, a moving stage for work pieces is used to meet the production requirements. Therefore, in this chapter, we focused on the feasibility of fabricating large-area TiO_2 UV-protective thin-film via AP-PECVD. TiO_2 thin-films with 8 × 8 mm area were fabricated successfully with different deposition time using moving stage for substrate. Similar roughness and UV-vis spectra measured in different places indicated good uniformity of AP-PECVD-derived TiO_2 large-area thin-film. With increasing deposition time, transmittance in the UV light region increased and transmittance in the visible light region decreased due to the increased roughness. Finally, a TiO_2 film with 8 × 8 mm area, and with greater than 99 % UV light blockage and greater than 95 % transmittance of visible light was obtained using moving stage for substrate.

Chapter 5 is "**Summaries**". The conclusion of each part was summarized in this chapter, and the perspective was proposed for a future research.