Fabrication of Anti-reflection Structure Film using RTR Ultraviolet Nanoimprint Lithography

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Anti-reflection (AR) film is very useful for prevention of light reflection on mobile phone and tablet computer. In particular, AR structure (moth-eye structure) film has high performance on prevention from light reflection. Our previous study reported that anti-reflection structure was fabricated by oxygen ion beam irradiation to glassy carbon (GC) [1]. The fabricated pattern was self-assembled conical structure and low reflection surface. In this study, we transferred AR structure film by roll to roll UV nano-imprint lithography (RTR UV-NIL) with replica mold[2]. This replica mold was fabricated from AR structure GC master mold.

First, moth-eye structure was fabricated by oxygen ion beam etching of glassy carbon (Tokai Carbon Co., Ltd). Oxygen ion generated by EIS-200ER (ELIONIX Co.) ion beam apparatus equipped with electron cyclotron resonance (ECR)-type ion source. Next, patterned surface was release coated by fluorinate silane coupling agent (Optool DSX/Daikin Co.).

Next, to obtain replica mold, photo-curable resin (PARQIT OEX-028-X433-3, Autex Co., Ltd) was dropped on the GC master mold, and which was then covered with polyester film (Cosmoshine A4300/Toyobo Co., Ltd). UV light was irradiated through the polyester film. This mold was heat-treated at 80℃ for 30min as the release treatment[3].

Figure 1 shows the schematic diagram of RTR UV-NIL process and transfer conditions. Our RTR UV-NIL system has aluminum roll mold (ϕ = 150mm). The replica molds were wrapped around roll mold using double-sided adhesive tape. Feed speed was 1.8m/min and photo-curable resin (PAK-01 CL, Toyo Gosei, Co., Ltd) was directly dropped onto replica mold. Figure 2 shows 75° angle SEM photos of (a) replica mold and (b) RTR transferred AR structure film. Figure 3 shows graph of (a) Reflectivity and (b) Transmittance of RTR transferred AR structure film. Measurement equipment was UV and visible spectrophotometer (V-630/JASCO Co.). As a result, we can successfully obtain the AR structure film with less than 0.1% reflectivity and was more than 95% transmittance in a visible light wavelength (λ ＝400-1000nm).

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2. J. Taniguchi, H.Yoshikawa, J. Vac. Sci. Technol., B30 (2012), p. 06FB07
3. K.Yajima, J.Taniguchi, Microelectron. Eng. 110 (2013) 188–191

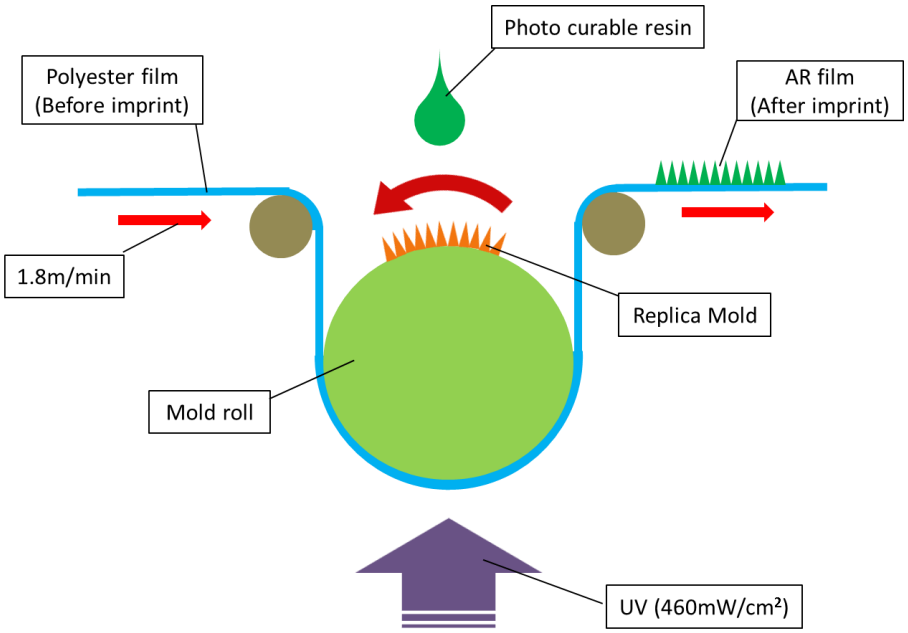

Figure 1: The RTR UV-NIL system and experimental conditions.

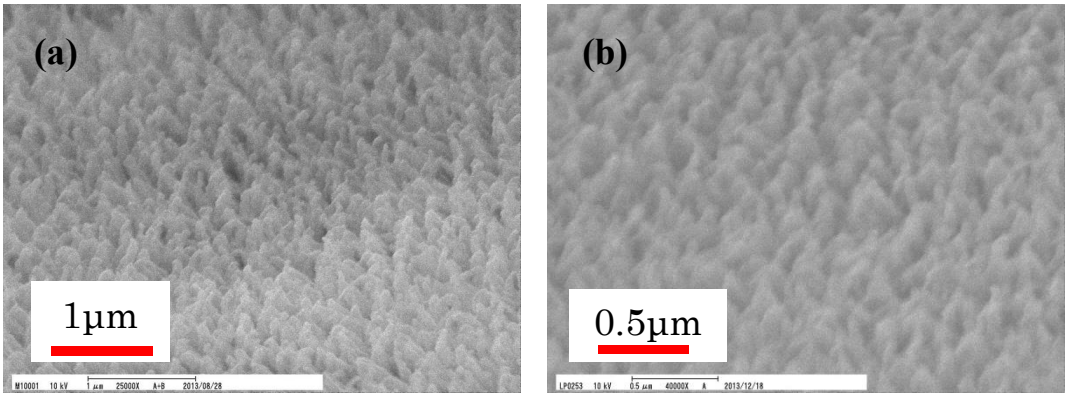

Figure 2: SEM photos. (a)Replica mold (b) Transferred AR structure film

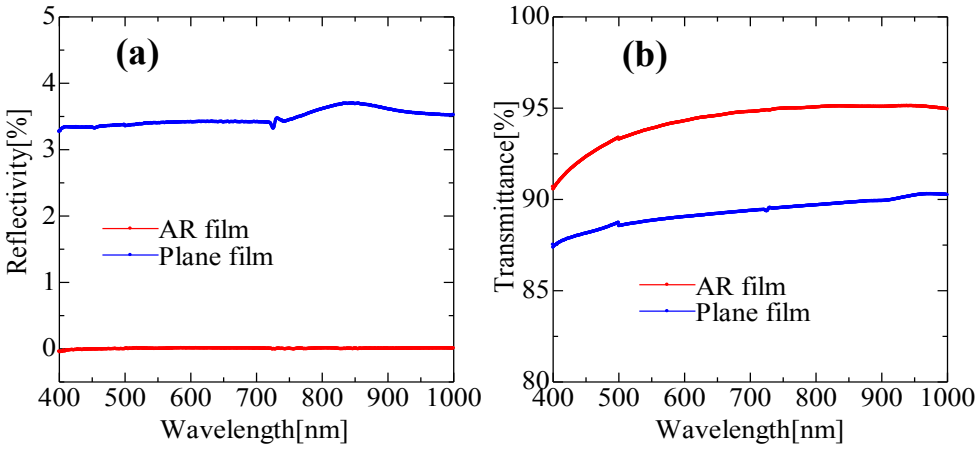

Figure 3: Evaluated optical quality (a) Reflectivity (b) Transmittance