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Poster Presentation B 18 July, 2019

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Continuous production of super-hydrophobic thin film by roll-to-roll system

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ABSTRACT

In this paper, we describe a PUA based hydrophobic film made by the reusable PDMS mold and roll-to-roll technique. The PUA based hydrophobic film has optically transparent and shows the self-cleaning effect. The liquid condition of the PUA makes them to be various micro-patterns by using the mold. The PUA-based hydrophobic film including microstructures has high durability as compared with the PDMS hydrophobic film. The optically transparent PUA-based hydrophobic film can be applied to the outer wall of the building glass or the solar panel.

Keywords: Hydrophobic film, Roll to Roll, Continuous production

1. INTRODUCTION

Superhytrophbic thin films have a great potential in various industrial areas. A lot of microfabrication techniques have been proposed to find more effective ways for successful commercialzation of the function surfaces. Hower, most of techniques developed have the limitaiton in optical transparency of the films. Here, we propose a novel fabrication method for mass production of an optically transparent hydrophobic thin film. A material of the proposed hydrophobic film was based on the UV curable PUA resin. This allows us to employ a roll-to-roll technique and continuous production of the functional thin films. A customized roll equipment was manufactured and the process optimization for continuous production of film was completed. The PUA based hydrophobic film produced has high transmittance, and can be applied to various substrates such as flexible films and glass substrates. The power generation efficiency through the self-cleaning of the solar panel using the super water-repellent film was analyzed and the practical application possibility was examined.

2. Roll to Roll based hydrophobic film fabrication

2.1 Fabrication

The fabrication method of super-water-repellent film used in this paper is divided into two processes as shown in Figure 1 (a)-(g). The first is a nickel and PUA based master mold manufacturing process. The second is the production of a large-area hydrophobic film using a roll-to-roll process. Figure 1 (h) and (i) show the fabricatied hydrophobic film by using the manufactured PUA master roll. For hydrophobic film fabrication, we have optimized an UV exposure time, and film transfer speed. When manufacturing PUA film using the roll equipment, it may cause undesired wrinkles due to heat generation during the UV curing process. To overcome this problem, we need to adjust the feed rate and PUA volume. After various process changes were optimized, the PUA-based water-repellent film was completed using the film transfer rate of 150 mm/min and the UV light quantity of 1650 mJ. In order to maximize the surface water repellency effect, nanosilica is spray-coated onto the surface of the microscaled PUA surface which further maximizes the water repellency. The produced PUA hydrophobic film has a high water repellent angle of about 140 degrees and has a high optical transparency. In the final experiment, power generation efficiency was measured by applying PUA hydrophobic film onto solar cell panels. Experimental results are shown in Table 1. It was also confirmed that the difference in power generation efficiency by sunlight is reduced by about 2%, which shows that it has almost no influence on power generation efficiency.

3. CONCLUSION

This paper presents an effective method for continue producing of the PUA-based super water-repellent film with high transmittance. The PUA used in this paper has a short UV curing time and high durability. The fabricated hydrophobic film shows a high optical transparency and high water contact angle. The fabricated films can be attached to the solar panel and the power efficiency test was experimentally confirmed.

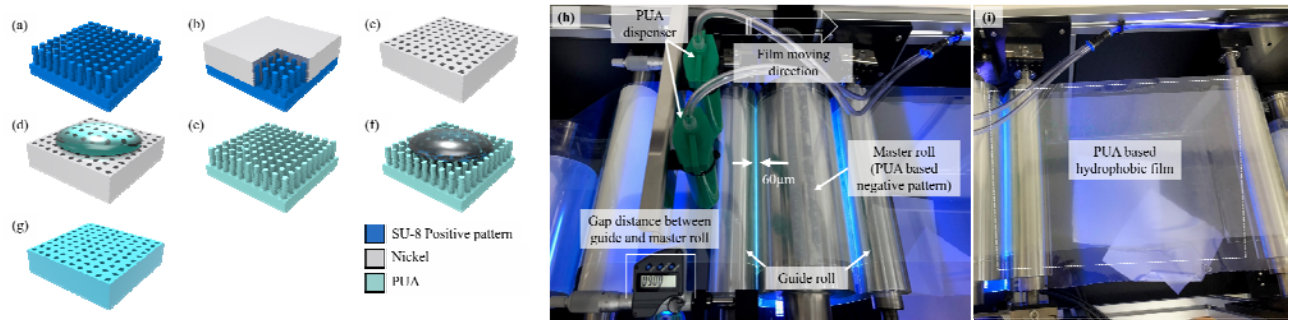

Figure 1. (a)-(g) Fabrication process flow of the PUA based Hydrophobic film by using Roll processing (a) SU-8 positive micro pattern mold by using MEMS process. Pitch distance of the post is 40μm, (b) Nickel deposition on SU-8 pattern by using the electroless plating, (c) after electroless plating release from the SU-8 mold, (d) PUA coating on the negative micropost pattern on nickel mold, (e) UV expose about 1620mJ, and release from nickel mold, (h) The photograph of the Roll to Roll mass production process and (i) Fabricated PUA film

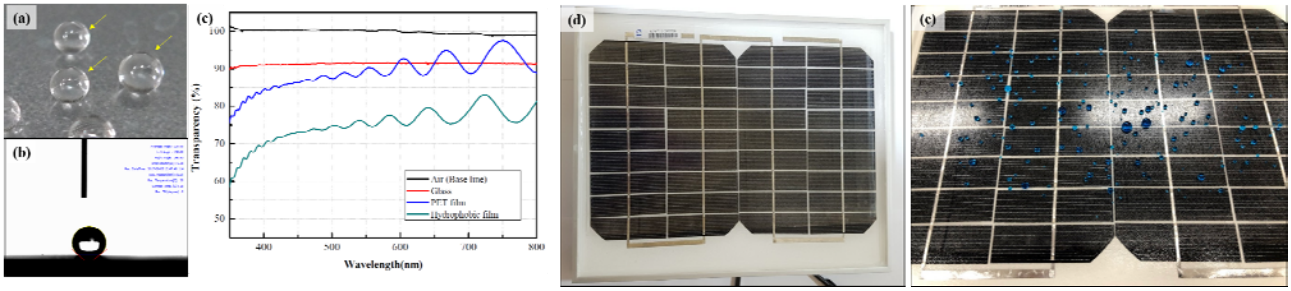

Figure 2. (a) and (b) water drop test of the hydrophobic film, (c) evaluation of the transparency test compare with several specimens, (d) and (e) the fabricated PUA based hydrophobic film attached on the solar panel

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REFERENCES

1. T. S. Lin, C. F. Wu and C. T. Hsieh, Enhancement of water-repellent performance on functional coating by using the Taguchi method, Surface and Coatings Technology, 200(18-19), 5253-5258, 2006
2. S. Dai, W. Ding, Y. Wang, D. Zhang and Z. Du, Fabrication of hydrophobic inorganic coatings on natural lotus leaves for nanoimprint stamps, Thin Solid Films, 519(16), 5523-5527, 2011
3. Z. Yuan, H. Chen, and J. Zhang, Facile method to prepare lotus-leaf-like super-hydrophobic poly (vinyl chloride) film, Applied Surface Science, 254(6), 1593-1598, 2008
4. Y. Yoon, D. W. Lee, and J. B. Lee, Fabrication of optically transparent PDMS artificial lotus leaf film using underexposed and underbaked photoresist mold, Journal of Microelectromechanical Systems 22(5), 1073-1080, 2013
5. I. P. Parkin and R. G. Palgrave, Self-cleaning coatings, Journal of materials chemistry, 15(17), 1689-1695, 2005
6. C. L. Park, H. E. Jeong, S. H. Lee, H. S. Cho and K. Y. Suh, Wetting transition and optimal design for microstructured surfaces with hydrophobic and hydrophilic materials, Journal of colloid and interface science, 336(1), 298-303, 2009