The Photopolymer Science and Technology Award

The Photopolymer Science and Technology Award No. 192200, the Best Paper Award 2019, was presented to Satoshi Takei, Makoto Hanabata, Kento Mizui, Kazuho Kurematsu, and Shinya Nakajima (Departments of Mechanical Systems Engineering and Pharmaceutical Engineering, Toyama Prefectural University) for their outstanding contribution published in Journal of Photopolymer Science and Technology, **31**, (2018) 289–294, entitled “Reduction of Defect for Imprinted UV Curable Resin including Volatile Solvents using Gas Permeable Mold Derived from Cellulose”.

Satoshi Takei

Satoshi Takei is a professor of the Electronic Material Laboratory at Toyama Prefectural University, and a visiting academic staff in Osaka University from 2010. He was a member of the research staff in the electronic research laboratory of Nissan Chemical Industries from 1998 to 2010. In 2001, he was a visiting assignee of SPT-Lithography in IMEC. He received his Ph.D (D. Eng.) (2009) in Osaka University, Japan. In 2009, he was a visiting scientist of Prof. C. Grant Willson laboratory in University of Texas at Austin and the National Nanotechnology Infrastructure Network (NNIN). His current interests are multifunctional materials and advances in patterning technologies and lithography processes.

Makoto Hanabata

Makoto Hanabata is a visiting professor of the Electronic Material Laboratory at Toyama Prefectural University from 2014. He was an associate managing director of Nissan Chemical Industries in Japan from 2006 to 2014. He was a managing director of KRI International, a contract research / consultation company, from 1997 to 2006. He was a director of Photo-functional Department, Osaka Research Laboratory of Sumitomo Chemical Company LTD. from 1976 to 1997. He received his Ph.D. from Osaka University (Japan) in 1993. His current interests are photo-functional materials especially for electronic application such as display, semiconductor, energy devices, etc.

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Kento Mizui is a master's degree student investigating with Prof. Takei at Toyama Prefectural University, Japan. He received his bachelor degree in mechanical systems engineering from Toyama Prefectural University. His research interest is microfabrication technology. He is focusing on, gas permeable mold derived from cellulose using in nanoimprint process.

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The mainstream of microfabrication technology is a photolithography [1,2]. Photolithography is a suitable process that can transfer geometric patterns to a film or substrate. However, due to the increasing cost to achieve high resolution, it reaches to the limitations. In this situation, imprint lithography (IL) has drawn much attention because of its high productivity and low cost. The IL is a processing method [3,4]. It was reported that it is possible in transcription of 10 nm [5]. This technique has a high resolution, high throughput, high aspect ratio patterning, cost reduction, and large area patterning [6-10]. The applicability of IL has wide varieties of biosensor, optical materials, and compact discs. [11-13]. It is promising as the next generation microfabrication technologies. A gas impermeable quartz mold used in conventional processes often causes air trapping and out gas accumulation between the mold and the transfer material. To solve the air trapping problem, the use of pentafluoropropane was suggested [14]. In previous studies, we reported a gas permeable mold derived from cellulose reduces the void caused by the outgas from acrylic material including acetone

[15-17]. The pattern failures caused by the air trapping and the outgassing between the mold and the UV curing liquid material were removed because these gasses easily passed outside through the gas permeable mold.

This paper reports a new family of imprint mold that the authors have recently developed. Mass productivity of the gas permeable mold from quartz master mold was confirmed by replicating a large amount of gas permeable mold. Defects in line and space patterns of the UV-cross-linkable materials including 10 wt% of acetone, 10 wt% of 1-methoxy-2-propyl acetate and 10 wt% of cyclopentane as volatile solvents were greatly eliminated by using the developed gas permeable mold derived from biomass.

These results were also presented at the International Conference of Photopolymer Science and Technology in 2018. The work on the imprint lithography has recently greatly progressed, providing novel structures of gas permeable molds derived from biomass. This approach is expected to expand the utility of non-liquid materials which need solvents that are currently not suitable for

imprint lithography. The progress will be presented at the International Conference of Photopolymer Science and Technology in 2018 [17].

The results presented in this paper provide a new useful family of imprint molds with unprecedented advantages, and hence deserves the Photopolymer Science and Technology Award.

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