Research and Development on Process Science and CD Control in High-Throughput UV Nanoimprint

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UV-nanoimprint is a promising nanofabrication technology at a low cost. Vacuum environment is attractive for UV-nanoimprint because of elimination of bubble defects caused by trapped air. However, to take advantage of cost effectiveness, we think that UV-nanoimprint should be carried out without vacuum. Step and Flash Imprint Lithography [1] which employs droplet dispensing system is a smart solution for avoiding gas trapping without vacuum but it is not compatible to common spin-coat method which is indispensable to achieve a high-throughput. Hiroshima of AIST proposed UV nanoimprint in pentafluoropropane [2] as a viable solution for bubble free nanoimprint using a spin-coat UV-nanoimprint resin without vacuum. We call this "***Hiroshima method***".

Japan Science and Technology Agency (JST) is an independent public body of the Ministry of Education, Culture, Sport, Science and Technology (MEXT). JST plays a key role in implementing science and technology policies formulated in line with the nation' Science and Technology Basic Plan. With an aim to promote and encourage the development of breakthrough technologies, JST provides various funding opportunities and strong support system for ambitious researchers. CREST (Core Research of Evolution Science & Technology) is one of JST' basic research promotion programs.

Combined teams of University of Hyogo, AIST, Osaka Prefecture University and Tohoku University applied for CREST program in 2008. The project title is "Research and Development on Process Science and CD Control in High-Throughput UV Nanoimprint" The project was adopted by making an appeal "***Hiroshima method***" as a breakthrough technology to achieve a high-throughput using a spin-coat resin. The project period and budget are 5.5 years (2008-2014) and 3.5 million dollars.

The key issues to resolve to achieve a high-throughput nano-manufacturing using UV-nanoimprint are as follows: (1) “unfill defects”, (2) “pull-out defects” and (3) “durability of antisticking layer”. We apply “***Hiroshima method***” to solve “non-fill defects”. For “pull-out defects”, we develop a new adhesion layer between a resin and a wafer. Furthermore, we research on an adhesion force and a friction force between a mold and a resin to develop a high-durability antisticking layer. We also develop UV-nanoimprint simulator, because the numerical simulation is an important tool to understand UV-nanoimprint process such as a bubble trapping and a demolding.

In the presentation, we will focus on the key outcome of the project.

[1] M. Colburn et al., Proc. *SPIE*, **3676** (1999) 379.
[2] H. Hiroshima et al., Jpn J. Appl. Phys., **46** (2007) 6391.