Direct UV-imprint Lithography using Conductive Nanofillers-dispersed UV-curable Resin

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UV nanoimprint is a direct nanostructuring process with several potential advantages over photolithography. Presently applied nanoimprint process scheme is based on the use of sacrificial resist. Meanwhile, current work proposes an idea of using conductive nanofiller (Ag) -dispersed UV curable resin for UV-imprint. Imprinted patterns become electrically conductive as the dispersed fillers are sintered and thus can be used directly as electronic structures without the need of separate metal processing. Therefore, the productivity of NIL is substantially improved. Synthesis and lithography applications of Ag particles-immersed UV curable resin have been previously investigated by Lin *et al* [1], and by EPFL researchers [2]. Recently, their extended use to thermal imprint was attempted by Kang *et al* [3], reported in NNT conference 2006 (nanoimprint and nanoprint technology).

In present work, as-received Ag solution (20 wt%, 20nm in diameter) was applied to HEMA (hydroxyethyl methacrylate) with the addition of photoinitiator. After mixing by vortex shaker and ultrasonic sonication, Ag-dispersed resin is properly dispensed on heated substrate (90~100°), and remained for 3~4min to evaporate Ag solvent completely. Then, the imprint was performed with glass stamps with both positive and negative master patterns for three min (UV intensity ~36.6mW/cm^2). As the imprinted patterns become sintered (Fig.1), the electrical resistivity is reduced because Ag particles get aggregated to create tightly networked current paths. Two-point measurement of surface electrical resistivity yields 15.4Ω/□ with standard deviation of 4.7Ω/□ (30.5%), compared to those of pure Ag film (6.4Ω/□).

[1] W.T. Cheng, Y.W. Chih, and C.W. Lin, J. Adhesion Sci. Technol. **19** 511 (2005)
[2] S. Jiguet, A. Bertsch, H. Hofmann, and P. Renaud, Adv. Eng. Mater., **6** 719 (2004)
[3] S.N Kang *et al*, Proceeding of NNT 2006 Conference, San Francisco, 2006, p.79

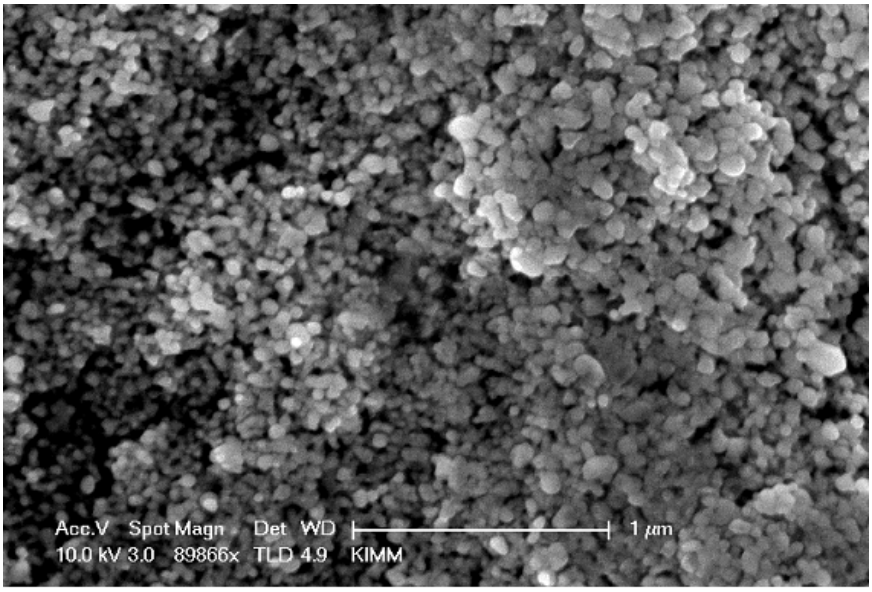

Fig 1: Ag particles are crosslinked through sintering to create electron transfer channels in the imprinted film (Diameter of Ag aggregate ~ 50nm)