Hierarchical structure formation induced by dewetting and imprinting and its pattern replication

I. T. Pai[1], D. W. Chiou[1], M. H. Hon[1], and I. C. Leu[2]
[1]*Department of Materials Science and Engineering, National Cheng Kung University, Tainan 701, Taiwan*
[2]*Department of Material Science, National University of Tainan, Tainan 700, Taiwan*

We report on the fabrication of microstructures of polyimide (PI) by imprinting with the assistance of a residual solvent.[1] The controllable PI hierarchical structures could be obtained by using various concentrations (2, 3, 4, 5 wt %) of poly-amic acid (PAA) in γ-butyrolatone-NMP mixture solution through imprinting and dewetting. The polydimethylsiloxane (PDMS) stamps used here have domes 5.8 μm in diameters, 2.8 μm in height and 8 μm in pitch. The PAA solution with various concentrations were spin coated onto the Si wafers and imprinted at 180 ºC for 10 minutes. After imprinting, the stamps were removed as the samples were cooled down to room temperature and then cured by hard baking at 250 ºC for 20 minutes. The samples were immersed in an electroless metal deposition solution (0.02 mM concentration of copper sulfate in buffer oxide etching solution) to confirm the PI patterns with hierarchical structures A hierarchical structure could be defined in the following figure, where the domes were formed by imprinting and the smaller area at the center of the four domes was due to the dewetting phenomenon. Figure 1 shows the scanning electron microscopy images formed by electroless metal deposition on Si substrate after imprinting PAA with concentration (a) 3 wt % and (b) 2 wt %. The area at the center of four domes could be controlled by using various concentrations of PAA.

Keywords: dewetting; soft lithography; solvent-assisted imprint; poly-amic acid (PAA)

---

[1] I. T. Pai, I. C. Leu and M. H. Hon, *J. Micromech. Microeng.* **16**, 2192 (2006)

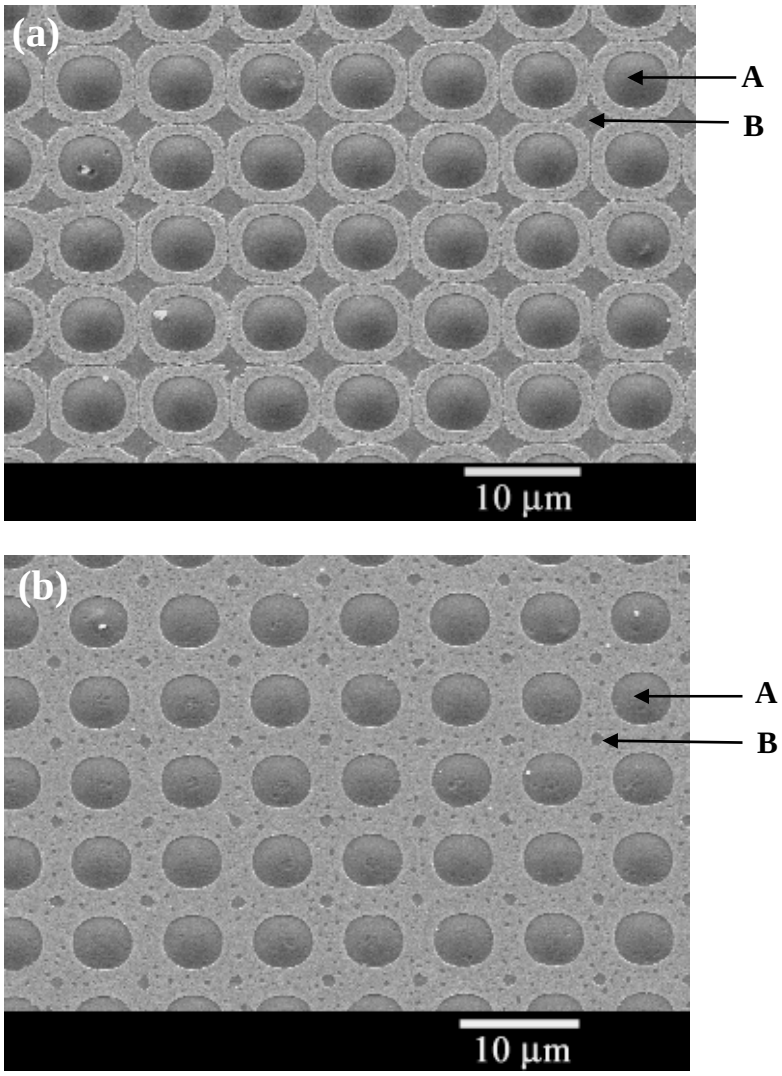

Fig. 1: Scanning electron microscopy images of patterns formed by electroless metal deposition on Si substrate after imprinting PAA with concentration (a) 3 wt % and (b) 2 wt %. The PI patterns formed by imprinting and dewetting were marked as A and B, respectively.