

Fabrication of Metallic Microstructures using X-ray Lithography Process

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X-ray lithography is one of micro-fabrication techniques which has been applied to generate microstructures based on batch fabrication process [1-2]. Soft X-ray from synchrotron radiation is exposed through X-ray mask to define irradiated areas in photoresist, resulting in vertical sidewall structures used for micromolds. Metallic microstructures such as nickel, copper, silver, and gold can be formed in these micromolds by electroforming method. Figure 1 shows the developed photoresist which was applied as micromolds for metal electroforming, and figure 2 displays metallic microgears made of nickel released from substrate after electroforming process.

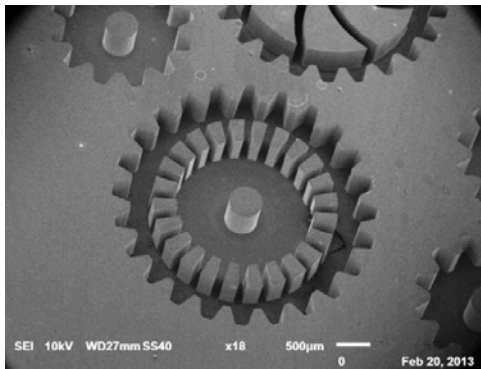


Fig. 1. SEM image of micromolds for metal electroforming.

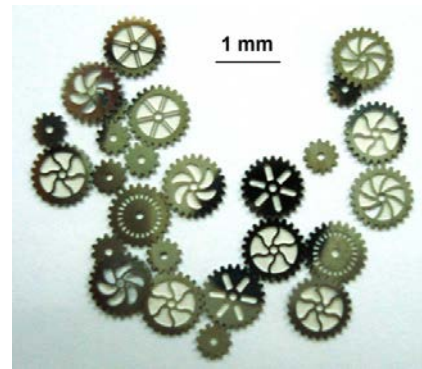


Fig. 2. Microgears made of nickel released from substrate.

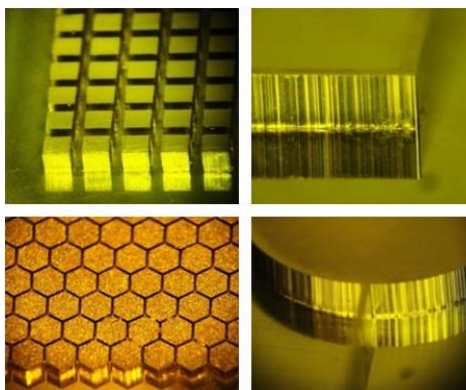


Fig. 3. Metallic micromolds for PDMS replication in microfluidic applications.

Deep X-ray lithography based on synchrotron radiation can provide thick microstructures layer from several micrometers to millimeters with high aspect ratio up to 40. The structures with sidewall roughness in the range 20 to 30 nm have been used in optical, micro-fluidic and mold insert applications. Figure 3 shows metallic micromolds for PDMS replication applied in microfluidic applications. As X-ray lithography is a unique tool for batch fabrication, it can be used to generate certain structures which could not be manufactured with any other tool. Industrial process can apply this technique in micromolds fabrication and used the micromolds in plastic injection machine.

[1] K. Kim, et al., *Microsystem technologies*, **9**, (2002).

[2] M. Wissmann, et al., *Proc. Of SPIE*, 6992 (699208) (2008).