

X-ray mask fabrication for synchrotron radiation lithography at the Advanced Photon Source (APS)

Joshua J. Song

Accelerator Systems Division, Argonne National Laboratory, 9700 S. Cass Avenue, Argonne, IL 60439, U.S.A.

Victor White

Dept. of Electrical & Computer Engineering, University of Wisconsin, 1410 Engineering Drive, Rm. 66, 92, Madison, WI 53706, U.S.A.

The possibility of fabricating mm-wave radio-frequency cavities (100-300 GHz) using the LIGA (in German: Lithographie, Galvanik, and Abforming) process, is being investigated. The deep x-ray lithography (DXRL) with a synchrotron radiation source is the first and most important procedure in the LIGA process. In order to use hard x-ray sources such as NSLS and APS for DXRL, masks with a higher x-ray contrast and better precision are needed. The precision mask was made by means of an intermediate mask--i.e., two steps. The first step was the photo-lithography. A plating base of Cr/Au or Ti/Au, usually 75/300, was used for the e-beam writer. Then 3 mm of Au was plated on an intermediate mask. The second step was DXRL using soft x-ray lithography at the Center for X-ray Lithography in Stoughton, Wisconsin (1-GeV Aladdin). In DXRL, the pattern was transferred from the intermediate mask into poly-methylmethacrylate (PMMA) on a 250 mm Si wafer and then electroplated with up to 40 mm of Au. To avoid alignment problems and x-ray fluorescence, these two steps were done on the same sample substrate--i.e., no physical gap. This paper will discuss considerations of the material, processing, and x-ray source associated with the mask fabrication for the mm-wave cavity micromachining.