EXPERIMENTAL VALIDATION OF THE COMPUTATIONAL MODEL OF APLANATIC SOLID IMMERSION LENS SCANNING MICROSCOPE

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ABSTRACT: Since solid immersion lens (SIL) microscopy introduced in [1] has attracted significant attention in the area of imaging solid state devices. Many researchers have experimentally demonstrated better resolution but the underlying optical model for the whole microscope was not fully understood. At best, the prediction of resolution based on focal spot size was studied [2, 3]. Recently, a complete modeling of subsurface microscopy system based on aplanatic SIL (ASIL) has been developed [4]. Before applying the model to the system parameter design and system optimization, the experimental validity and analytical cogency of the model should be verified. This presentation shall present the experimental validation of the model using a variety of object structures imaged using circular polarization. The imaging results shall be explained based on the analysis of intermediate variables of the model (induced current pattern and its radiation characteristics). Two examples of the experimental validation are given below in Figs. 1 and 2 (corresponding to concentric rings and L-shaped bars respectively). Experiment result are obtained using SEMICAPS ASIL microscope and the Metrochip resolution target [5]. It is found that the simulation results produced by the proposed model are in very good agreement with experimental results. Several more interesting examples shall be included in the presentation.


Fig. 1. A set of concentric rings to be imaged is located on the focal plane of ASIL. The ring radius (edge-to-edge) increases by 200nm.

(a) Object pattern used in simulation (b) Simulated image using our model (c) Experimental image

Fig. 2. L-shaped bars to be imaged is located on the focal place of ASIL. The line width and space between lines is S = 200nm. The length of lines is 50S.

(a) Object pattern (b) Simulated image (c) Experimental image
used in simulation using our model (the patterns surrounding the L-shaped bars are just feature markers)