

# Applications of the 3D electromagnetic model to some challenging optical problems.

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**Key words:** rigorous simulation, 3D modeling, lithography, optical recording

**Abstract:**

We discuss the applications of the 3D electromagnetic model to the following two problems.

1. Lithography problem: In the manufacture of ICs the designed pattern made in a metallic mask is imaged in a photoresist. To improve resolution, phase change masks are used. We have applied the model to the transmission of an incident plane wave of wavelength 193nm by a 3D structure in the mask. The computational volume is approximated  $3.5 \times (\text{wavelength})^3$ . The refractive index of the metal, the angle incidence of the plane wave and the topography of the mask have a large effect on convergence and cpu time. The results show that polarization effects induced by the mask depend strongly on the type of mask, the materials of which it is made, the wavelength of the illumination and the angles of incidence of the incident plane waves.

2. Optical recording problem: We study the interaction of a focused light spot with pits on an optical disc. In optical recording storage can be increased by decreasing the wavelength and increasing the NA of the lens. However, this cannot be done indefinitely. A new method is to use a so called Solid Immersion Lens(SIL). We will explain how it works and show some results of scattering calculations. To get more reflection, silicon has been used as substrate, the high real part of the refractive index of Si makes the computation very challenging.