Interferometric lithography on curved surfaces

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Recent work in meta-surface optics has indicated there may be advantages to placing the meta-surface on a curved rather than planar substrate. Most optical lithography methods possess a finite depth of focus which scales with the target resolution. The result is that patterning smaller features creates a smaller depth of focus, relegating these patterning approaches to planar substrates. Interferometric lithography (IL) is a patterning approach where the interference pattern produced by overlapping coherent laser beams is used to pattern photoresist (Fig. 1). One of the advantages of IL over conventional mask-based lithography is that the interference pattern exists throughout the entire volume the beams overlap. In this paper we discuss the ability of IL to pattern macroscopically curved surfaces, surfaces where the radius of curvature (ROC) is >> than the exposing wavelength. We show that there is a pitch-dependent coverage for curved surfaces (Fig. 2) relating the local ROC to the incident plane wave angle. We will also show example patterned curved substrates created using a simple Lloyd-mirror two beam interference configuration.

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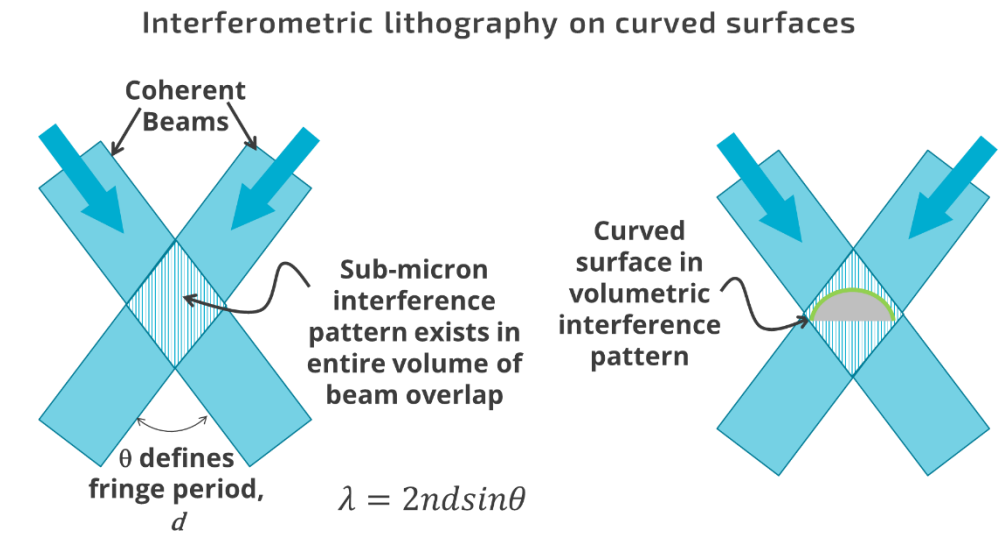

Figure 1: Interferometric lithography: A.) Interference pattern from two mutually coherent plane waves; B.) Interference pattern exists in the entire 3D volume of plane wave overlap - allowing us to pattern macroscopically curved surfaces.

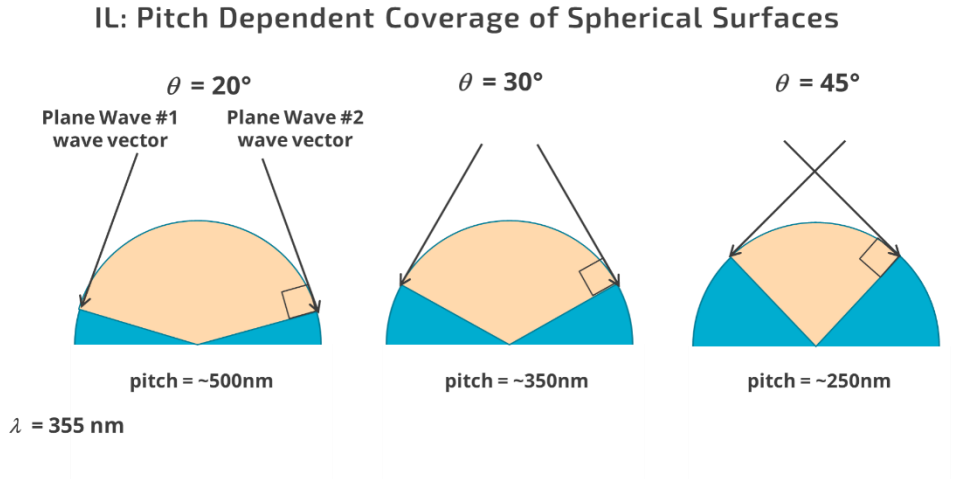

Figure 2: Coverage limitation of interferometric lithography on curved surfaces.