Recent development of nanoimprint and nanoreplication and applications

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Nanoimprinting has been applied in many micro- and nanoscale engineered devices; applications include displays, organic electronics, photovoltaics, optical films, and optoelectronics; and in some cases, direct imprinting of functional polymeric devices. Applications in the photonics area can significantly relieve the stringent requirement needed for nanoelectronics. We provide examples of structural colors and optical meta-surfaces facilitated by nanoimprinting, as well as plasmonic lithography masks that can produce deep-subwavelength structures using ordinary UV light.

Inkjet printing has been widely used in many applications, but still faces challenges in pattern precision and feature variations. Combining Nanoimprint for patterning and inkjet printing for material deposition will take the advantage of what both technologies can offer, and can provide a high precision additive manufacturing process. We will show printed photonic devices, e.g. electro-optic polymer based optical modulators.

To extend nanoimprinting to solid materials other than polymeric films will require innovative and non-conventional approaches. One such process is Metal-assisted chemical (Mac) imprint, which combines MacEtch and nanoiprint and enables direct MacEtch of Si substrate using a hybrid imprinting mold having noble metal mask. However, only low aspect ratio structures have been obtained because of the mass-transport limitation in the previous molds. Recently we effectively solved this problem by a using a specially made mold of Pt-coated anodized aluminum oxide (AAO) membrane, where the holes through the entire thickness drastically enhances the mass-transport. As a result, very high aspect ratio Si nanowires were achieved by MacImprint.