Gaptronics: Stretchable-Gap Embedded Metasurface for Electromagnetic wave Modulation

Mahsa. Haddadi. M, Bamadev. Das, Zhihao. Wang, Dai.Sik. Kim

Nano-Optics Group (NOG), Quantum Photonics Institute, Ulsan National Institute of Science and Technology (UNIST)

E-mail: mahsahm@unist.ac.kr

Metasurfaces made up of subwavelength structures called “meta-atoms” have drawn enormous attention from researchers due it’s unique capabilities in tuning the electromagnetic response. One of the important properties of this metasurface is the ability to confine a huge electromagnetic field, which is related to gap width. As the gap width decreases, the field enhancement increases. In this context, the gap-width control by means of external stimuli becomes an important issue. In this work, we report on the stretchable zero-gap sample, which is fabricated using atomic layer lithography. This stretchable zero-gap sample is a thin film in which interfaces are embedded periodically. These interfaces act as strain concentration centers when the sample is stretched mechanically. To create the gap in the sample, we simply apply strain which cracks the thin film at the interface. With the stretching, we could achieve a gap width as high as 4.5 μm for a 200 μm period and 1 μm for a 5 μm period. The gap width changes with respect to mechanical stretching are confirmed by FESEM imaging and optical transmission microscopy imaging. The electromagnetic transmission through the sample is measured in microwave frequencies (12-18 GHz), demonstrating complete manipulation of the electromagnetic wave.