Liquid-Metal-Fluidically Switchable Metasurface for Polarization-Insensitive and Broadband Absorption

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In this paper, we propose a switchable metasurface that has broadband absorption spectrum and insensitivity for polarization angle. The proposed metasurface can fluidically switch its absorption spectrum using microfluidic channel and liquid metal. Conventional metasurfaces using liquid metal and microfluidic channels for frequency switching have the disadvantage of being sensitive to changes in polarization because of the structure of the microfluidic channel in which the inlet and outlet must exist. However, the proposed metasurface implements polarization insensitive characteristics by using two separate patterns connected by liquid metal.

The proposed metasurface consists of the top metallic pattern on flexible printed circuit board (FBCB) substrate, polydimethylsiloxane (PDMS) substrate with laser printed microfluidic channel and ground plane. The top pattern consists of four circular sectors in the center and four isolated patches on the outside. They are made of a 90 degree symmetrical structure to realize polarization-insensitive characteristics. If liquid metal is injected into the channel, the circular sector and isolated patch are connected and the absorption spectrum is switched. For the measurement of the performance, the samples were fabricated with 10 x 10 unitcells. Eutectic gallium indium alloy (EGaIn) was used as liquid metal for switching.

To confirm that it is insensitive to polarization, the proposed sample was measured by changing polarization at normal incidence. When EGaIn is not Injected into microfluidic channel, the absorption ratio is over than 90% from 6.23 to 12.14 GHz. When EGaIn is injected into microfluidic channel, the absorption ration is over than 90% from 5.44 to 6.12 GHz. In both cases, there was no change in absorption spectrum according to polarization angle.

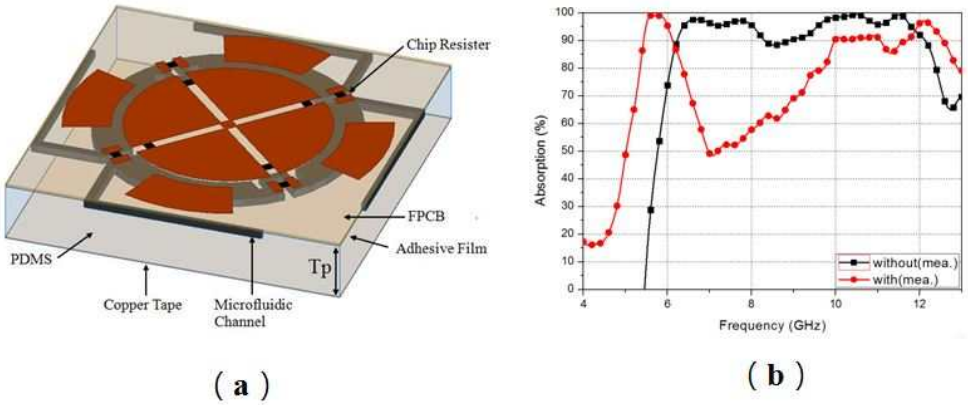

Figure 1. (a) 3D view of proposed absorber and (b) Measurement result of fabricated sample