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Polymer-based metalenses for THz beam engineering

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The rapid development of terahertz (THz) technology and its promising implementations in communications, security and other industries stimulates high demand for compact photonic components. Since conventional passive optics are bulky and severely limit the packaging options for photonic circuits, THz metamaterials-based photonics has attracted considerable attention. One of attractive options are metalenses, which are flat and flexible compared to conventional lenses and allow compact photonic integration into various optical devices and circuits. Generally, such metalenses are fabricated from highly conductive metallic materials to couple the THz field to the meta-surface cells.

In this work, we explore an alternative approach by using conductive polymers as the base material for the fabrication of metalenses. This brings several key advantages as polymers can be processed using solution-based methods and require lower laser patterning energies, which is particularly beneficial when depositing metalenses on sensitive substrates.

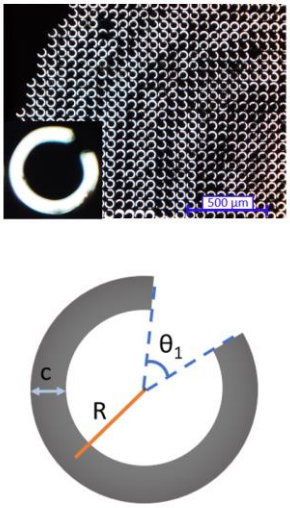

Fig. 1 Microscopic image of polymer metalens and its schematic design parameters.

Two different polymers – Clevios™ SV3 and Clevios™ PH1000 – were selected for metalens fabrication and designed for frequency of 300 GHz. For comparison, samples made from metal and graphite are studied. Beam shaping and spectral properties were investigated. Measurements show a good focusing and rather strong conductivity-dependent performance of the photonic components.

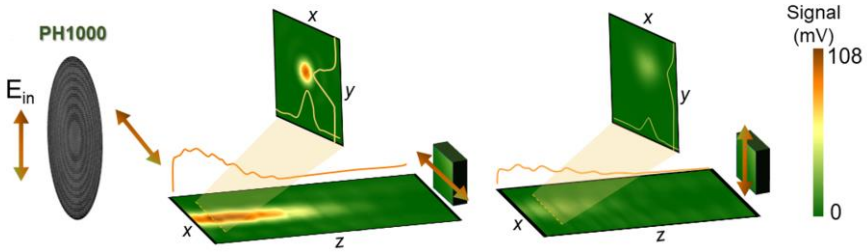

Fig. 2 Spatial beam distribution of the focused THz radiation using metalens based on PH1000.