Characterization of Novel Reconfigurable Mid-IR Metalenses Enabled by Phase Change Materials

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The mid-infrared (mid-IR) range on the electromagnetic spectrum is a crucial band for numerous industrial applications of cameras ranging from biomedical sensing to free-space communication. I theoretically analyzed and experimentally realized a metasurface platform capable of fulfilling a diverse cross-section of optical functions. Therefore, such novel metasurfaces satisfy the purpose of a mid-IR camera lens. Analyzing two different materials to target two sets of issues, both materials were constructed using high-index chalcogenide films. Such choices of wide-band transparent materials allow the design to be scaled across a broad infrared spectrum. Studying PbTe to target solving the size, weight, and power of the lens, I achieved meta-optical devices featuring an ultra-thin profile, being ?0/8 in thickness. The results additionally measured optical efficiencies of up to 75% representing major improvements over state-of-the art. Furthermore, a novel nanostencil fabrication method was created for the purpose of producing such PbTe metalenses. We then extended our metalenses to feature a reconfigurable feature using GSST, in which they are able to switch focal spots mechanically without having to remove and replace them. In other words, they are multiple lenses in one. The projected size, weight and power advantages, coupled with the manufacturing scalability leveraging standard microfabrication technologies, make these meta-optical devices promising for next-generation mid-IR system applications.

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