## 超薄结构薄膜的全光近红外成像

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近红外 (NIR) 视觉探测器和相机在成像、传感和显示等高科技技术中发挥着至关重要的作用。传统的近红外相机设备存在笨重、单色并且只适用于某些波段的缺陷，成为了限制该类设备应用的技术瓶颈。

英国诺丁汉特伦特大学的 Mohsen Rahmani 教授等人展示了一种能够覆盖所有这些频段的薄膜，而无需将光转换为电子，反之亦然。在这项研究中，他们采用了非线性超表面的概念。超表面是纳米级谐振器阵列，可以调控光的特性，包括光的传播方向、强度和波长 (或者颜色)。其中，能够转换光波长的超表面被定义为非线性超表面。Mohsen Rahmani 教授等提出了一种由硅薄膜构成的非线性超表面，薄膜上有精心设计和制造的纳米级孔 (即膜的几何形状)，能够与入射光发生强烈共振。当用近红外光照射该超表面后，会通过非线性过程 (即三次谐波生成 (THG)) 产生波长为原始波长 1/3 的新颜色。通过控制纳米孔阵列的对称性来调谐光的波长和强度，并最终实现近红外成像。这种用于近红外成像的新方法可以被广泛地应用到大频段和多色工艺。值得注意的是，所利用的材料硅，目前在 CMOS 工业中被大量使用，大规模地生产硅超表面不需要巨额投资。此外，硅不吸收波长大于 1000 nm 的近红外光，不存在加热问题。该工作报道的技术平台为下一代轻薄、廉价、宽带和彩色的近红外相机及探测器提供了基础。

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## Multi-foci metalens for spectra and polarization ellipticity recognition and reconstruction

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Conventional NIR cameras are bulky, heavy, monochrome and limited to certain wavelength bands. The latter is a major technological limitation because photocathodes are functional only in one of the following ranges: 400-1000 nm, 1000-2500 nm or >2500 nm.

The Advanced Optics and Photonics (AOP) group at Nottingham Trent University described a nonlinear metasurface composed of a thin silicon film. The film accommodates carefully designed and fabricated nanoscale holes, i.e. membrane geometry, that strongly resonate with the incoming light. After illuminating the designed metasurface with a NIR light, it generates a new colour at 1/3 of the original wavelength via a nonlinear process, so-called third harmonic generation (THG). By controlling the symmetry of the array of nano-holes, the researchers have demonstrated a versatile tool for tunning the light wavelengths and intensities, which is ultimately used for NIR imaging. Such an innovative approach for NIR imaging is widely expandable to large frequency bands and multi-colour processes. Worth noting that the exploited material, i.e. silicon, is being heavily used in the CMOS industry. Therefore, mass production of silicon metasurfaces does not need heavy investments. Moreover, silicon does not absorb NIR light in wavelengths >1000 nm, so heating is not a concern. Last but not least, silicon is a centrosymmetric material.

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