Selective multi-wavelength and narrowband infrared thermal emitters

Abstract Infrared thermal emitters with narrowband and spectral selective properties have gained much attention owing to their applications as light sources in miniaturized sensing systems. Due to the intrinsic molecular vibration modes, different gases or biochemical molecules have their own characteristic absorption spectra in the IR region, which can be utilized to determine the species of target analyte. Recently, we demonstrated a multi-wavelength and non-dispersive plasmonic thermal emitter consisting of double-stacked crossed-shaped metal-dielectric metal (MDM) structure. The un-symmetric crossed-shaped resonators were designed to independently control the gap-plasmon modes under x- and y-polarizations and perform four well-separated absorption bands in the mid-infrared range accompanied with strong polarization dependence. In addition, to boost up the quality-factor (Q-factor) of emission peaks, a hybrid Tamm plasmon (TP) structure was studied by introducing gold (Au) gratings on top of an alternative stacking germanium/Titanium dioxide (Ge/TiO2) distributed Bragg reflector and an Au film. Our experimental results show triple high-Q emission peaks at the wavelength range of 3–6 μm, corresponding to the excitation of the hybridized TPs and the gap-cavity (GC) mode. The GC emission peak can be adjusted freely by modifying the configuration of top Ge resonant cavity. These multi-band and high-Q infrared light sources enrich the capability of signal calibration and discrimination in molecular fingerprint analysis, which is beneficial for enhancing sensing accuracy or system functionality in one compact device.

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Venue

東京農工大学 小金井キャンパス
13 号館 4 階 L1342 講義室
Lecture Room L1342, 4F.,
Building 13, Koganei Campus, TUAT

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