Metasurface configuration for selective infrared radiation source

Ramona Calinoiu
Roxana Tomescu, Dana Cristea

National Institute for Research and Development in Microtechnologies, IMT Bucharest, 126A, Erou Iancu Nicolae Street, 077190, Bucharest, ROMANIA

ramona.calinoiu@imt.ro

Abstract

Our objective is to develop IR sources with high emissivity control based on a narrow band absorber. The emission control is achieved by placing a metasurface tailored to attain nearly 100% narrow-band absorption at desired wavelengths.
Metasurfaces are periodic arrays of metallic or dielectric subwavelength structures of various shapes and sizes with geometrically controlled electromagnetic characteristics [1]. These structures have the potential to control both the propagation and the emission of light at the micro or nanoscale and have found applications in holography, sensors, switches, high-resolution imaging [2-4].
We propose a metasurface consisting of an array of circular-shaped metallic resonators (figure 1a) with diameter in the order of micrometres. The role of this configuration is to improve the light absorption within a narrow band interval in the IR domain. The metasurface is patterned on top of a classical thermal source (figure 1b) consisting of a metallic resistor.
The specifically tailored metasurface, placed directly over the heater, absorbs all the radiation spectrum emitted and will emit only the wavelengths for which it is designed. Figure 2a presents a SEM image of the fabricated metasurface, and figure 2b shows an optical image of the resistor used as thermal classical IR source.

Figures

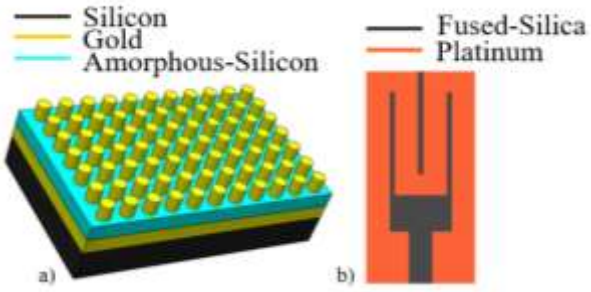

Figure 1: Thermal radiation source composed of: a) metasurface with tailored IR absorption spectrum and b) resistor based on meanders

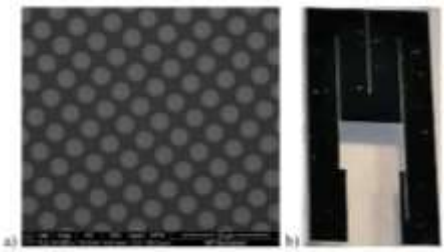

Figure 2: a) SEM image of the proposed metasurface and b) optical image of the resistor consists of two meanders

We designed and fabricated metasurfaces for IR sources with emissivity centred at 3.7μm and 5.4μm wavelengths suitable for gas sensing applications.

References

[1] Yijia H. et al, Nanoscale 10 (17), 2018
[2] Ji Luo and Yu-Sheng Lin, Appl. Phys. Lett. 114, 051601, 2019
[3] Inki Kim et, al, ACS Photonics, 2018, 510, 3876-3895, September 20, 2018
[4] R. F. Waters, et al, Appl. Phys. Lett.107, 081102, 2015