Nanostructured Devices for Wavelength-Selective Radiative Heat Transduction

T. Nagao[1,2]
[1]*International Center for Materials Nanoarchitectonics (NIMS), Tsukuba 305-044, Japan*
[2]*Department of Condensed Matter Physics, Hokkaido University, Sapporo 060-0810, Japan*
NAGAO.Tadaaki@nims.go.jp

Narrowband perfect absorption based on 2D nano architectures made of IR plasmonic materials can be utilized to achieve spectroscopically well-defined infrared sensors and thermal emitters [1-3]. In this talk, we introduce some of our recently developed infrared sensors combined with spectroscopic perfect absorbers for wavelength-selective infrared ray detection. The MIM metamaterial IR sensors with pyroelectric detection as well as thermoelectric detection exhibit resolutions better than 1um with wide acceptance angles. By adopting Gires-Turnois structures composed of low-loss metals, wavelength resolution better than 20 nm was achieved at operation wavelengths in the micrometer regime. The same design can be adopted also to narrowband thermal emitters when it is fabricated with refractive dielectrics and highly conductive ceramics that can sustain well above 1000 deg C. The combination with appropriate perfect absorber design and low-loss metals will open a new avenue for innovative technologies not only in true-temperature thermography, but also create industry seeds for low-temperature rapid heating by material-specific infrared heaters.

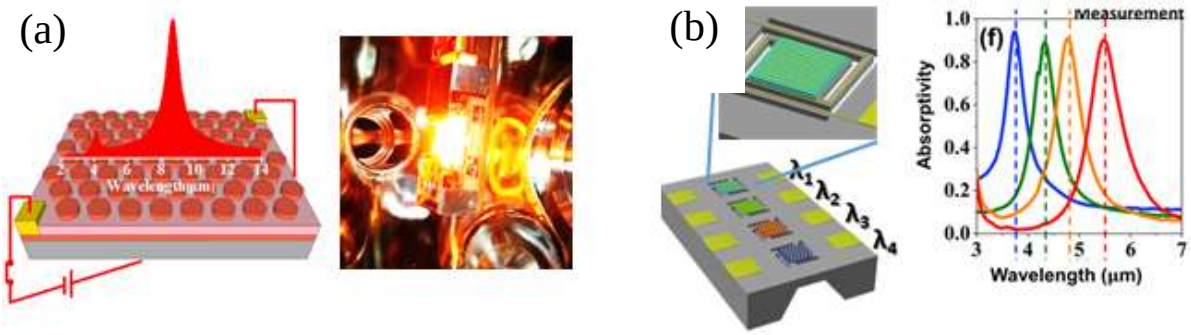

Figure 1 Schematics of (a) a spectroscopic thermal emitter and (b) a multiwavelength infrared sensor.

REFERENCES

[1] T.D. Dao, S. Ishii, T. Yokoyama, T. Sawada, S. Ramu Pasupathi, K. Chen, Y. Wada, T. Nabatame, T. Nagao, *ACS Photonics* 3, 1271-1278 (2016).

[2] T. Yokoyama, T. D. Dao, K. Chen, S. Ishii, R. P. Sugavaneshwar, M. Kitajima, T. Nagao, *Adv. Opt. Mater.* 4 (12), 1987-1992 (2016).

[3] A. T. Doan, T. D. Dao, S. Ishii, and T. Nagao, "Gires-Tournois resonators as ultra-narrowband perfect absorbers for infrared spectroscopic devices," *Optics Express* 27 (12), pp. A725-A737 (2019).

[4] T. D. Dao, S. Ishii, A. T. Doan, Y. Wada, A. Ohi, T. Nabatame, and T. Nagao, "Y. Wada, *Advanced Science* 6 (20), 1900579 pp. 1-9 (2019).