TRR 142
Tailored Nonlinear Photonics

TRR Guest Scientist Lecture / Seminar

Date/Time: 21.06.2017 / 16:00 Uhr
Location: Paderborn, P8.4.09

Gwanho Yoon
Pohang Institute of Science & Technology (POSTECH)
Pohang, South Korea

Metasurface-based reconfigurable visible light absorber

Abstract:

Metamaterials have been explored due to their extraordinary optical properties and unprecedented phenomena such as negative refractive index [1,2], invisibility cloak [3,4], super-resolution imaging [5], artificial chirality [6], electromagnetically induced transparency [7], perfect absorber [8] and so on. Although many interesting phenomena have been introduced, there are technical limitations. Most of the metamaterials demonstrated before were passive type, so their optical properties cannot be changed after fabrication. This limitation is a critical obstacle of conventional metamaterials to outperform typical optical and electronic devices. A few works to control the optical properties of fabricated metamaterial devices by using electrical, optical, thermal and mechanical methods have been reported. However, they have severe problems to solve such as low working frequency, low modulation speed and insufficient integration feasibility.

Hereby, we suggest ITO as an active layer of the tunable metamaterial perfect absorber to solve aforementioned issues. Intrinsic ITO is not suitable for tuning in the visible wavelengths, so its carrier concentration has to be tuned to appropriate value by optimizing fabrication conditions such as annealing process. According to the simulation result, the suggested device can perfectly absorb a certain wavelength and handle the absorption wavelength within the visible region. It has many potential applications such as optical logic elements, ultrafast visible tunable band-pass filter, reflective display and military stealth technology. Moreover, tuning mechanism of ITO at visible region can convert the past passive metamaterials to the active metamaterials, for example, tunable meta-hologram, ultrafast optical modulation and active wavefront manipulation opening a new generation of photonics beyond metamaterials.

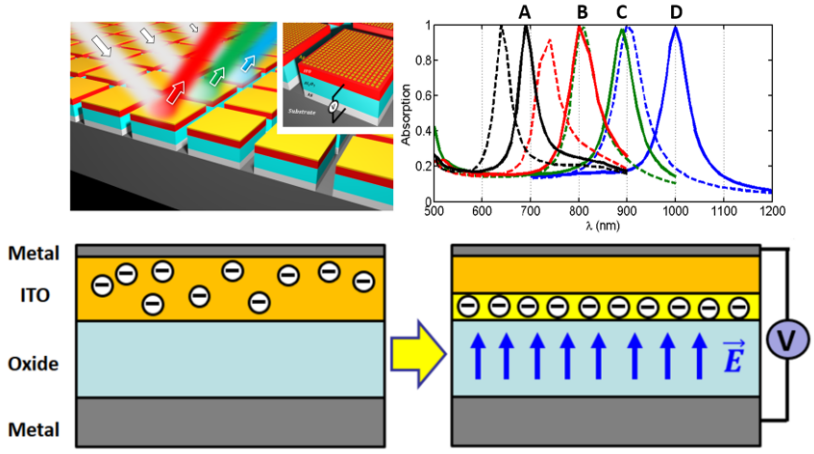

Fig 1.
Schematic of the device and free electron distribution in ITO layer with external voltage

References

[1] V.G. Veselago, Sov. Phys. Usp. **10**, 509-514 (1968)
[2] J. B. Pendry, Phys. Rev. Lett. **85**, 3966-3969 (2000)
[3] D. Shurig et al., Science **314**, 977-980 (2006)
[4] W. Cai et al., Nat. Photon. **1**, 224-227 (2007)
[5] N. Fang et al., Science **308**, 534-537 (2004)
[6] S. Zhang et al., Nat. Comms. **3**, 942 (2012)
[7] S. Zhang et al., Phys. Rev. Lett. **101**, 047401 (2008)
[8] N. I. Landy et al., Phys. Rev. Lett. **100**, 207402 (2008)

Contact: **Prof. Dr. Thomas Zentgraf**
thomas.zentgraf@upb.de

UNIVERSITÄT PADERBORN
Die Universität der Informationsgesellschaft

technische universität dortmund