杨毅彪科研团队简介

微纳光电子器件与技术课题组 导师团队

杨毅彪 博士
教授，博导

陈智辉 博士
教授，博导

曹斌照 博士
教授，硕导

费宏明 博士
教授，硕导

田媛 博士
副教授，硕导

张明达 博士
讲师

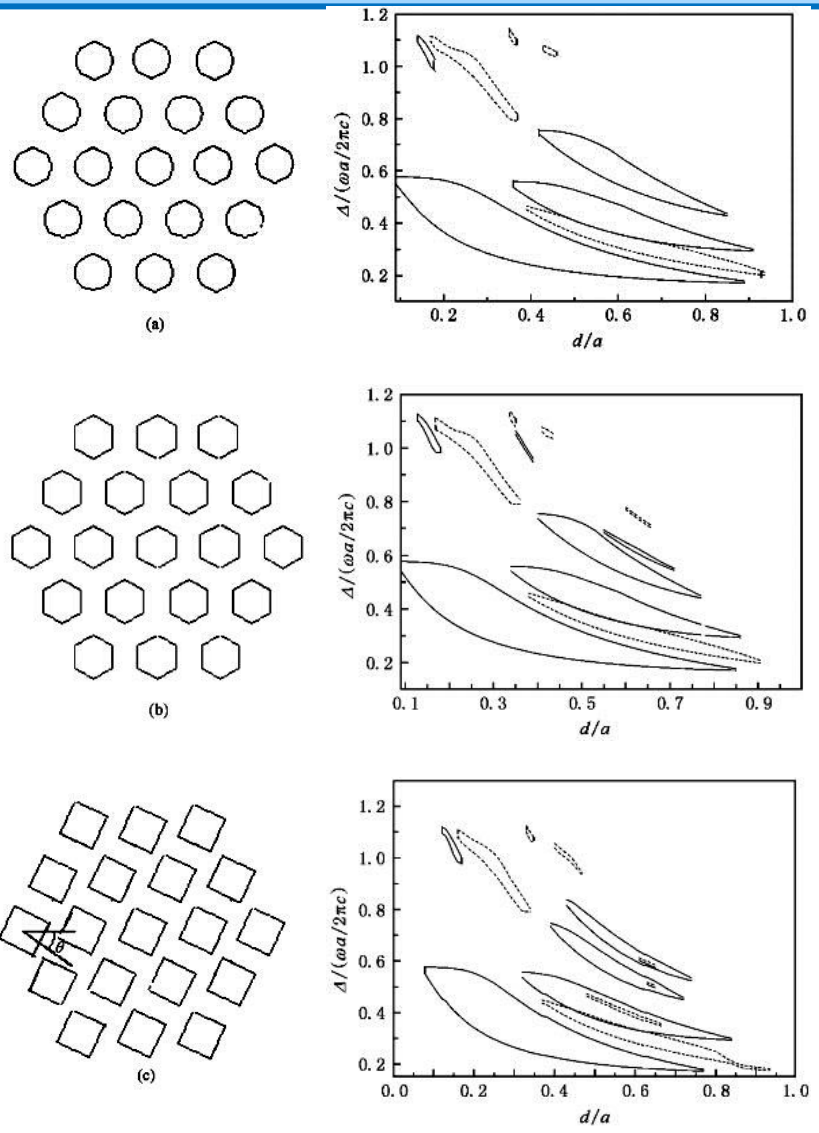
刘欣 博士
讲师，硕导

赵晓丹 博士
工程师

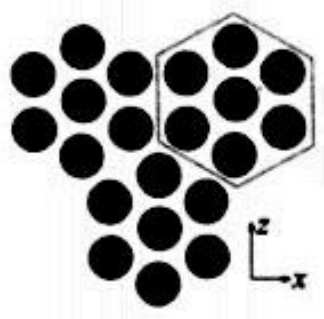
2. Research areas

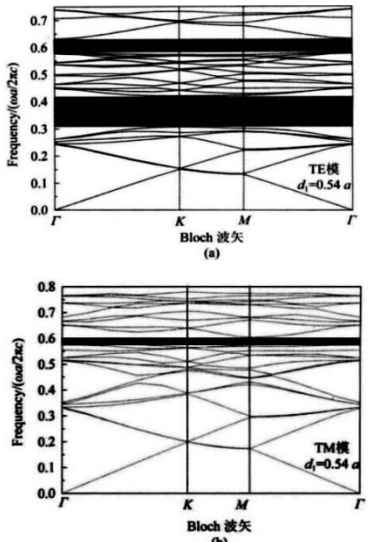
- Band gap and scattering characteristics of Photonic crystal
- Photonic crystal filter, isolator design
- Control characteristics and sensing of artificial electromagnetic materials
- Research on optical coupling structures in optoelectronic devices
- Quantum dot temperature and biosensing detection
- Micro-nano surface plasmon sensing and spectral enhancement
- Optical localization and conduction control technology of photonic crystal
- …

Photonic crystal band characteristics and applications in solar cell reflectors (Yibiao Yang)

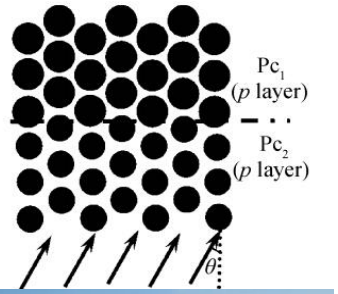


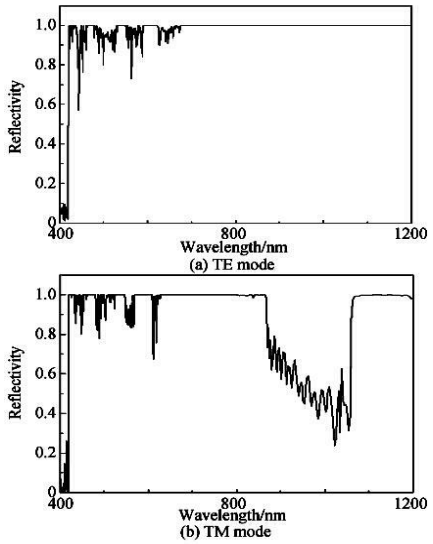
Yibiao Yang, Acta Physica Sinica **59** 671-675 (2010)





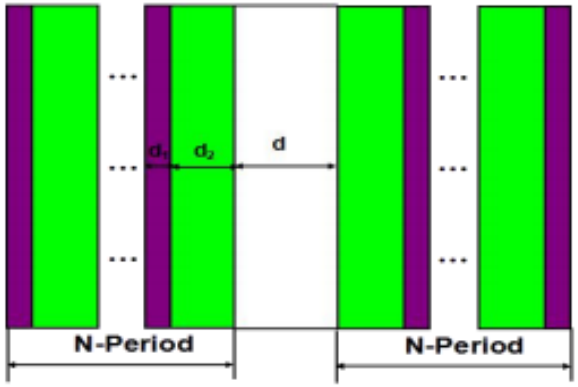
Yibiao Yang，Journal of Infrared and Millimeter Waves，31,306-310 (2012)

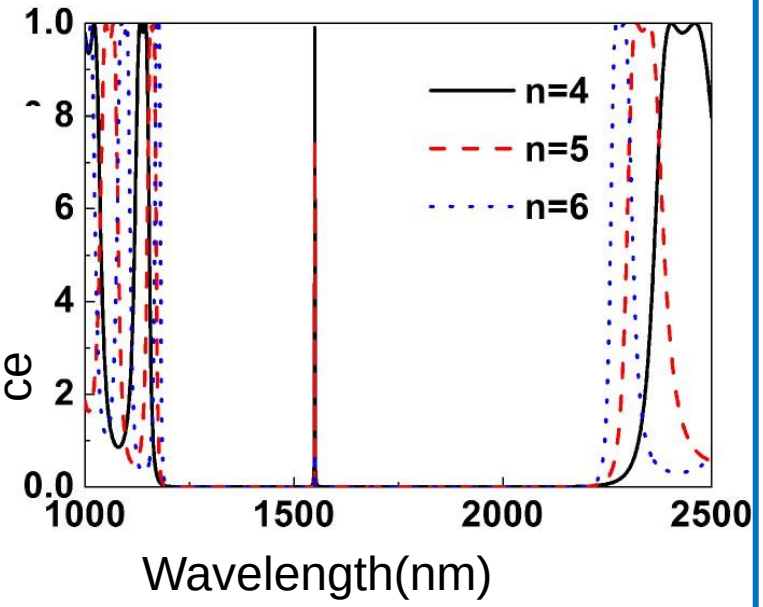


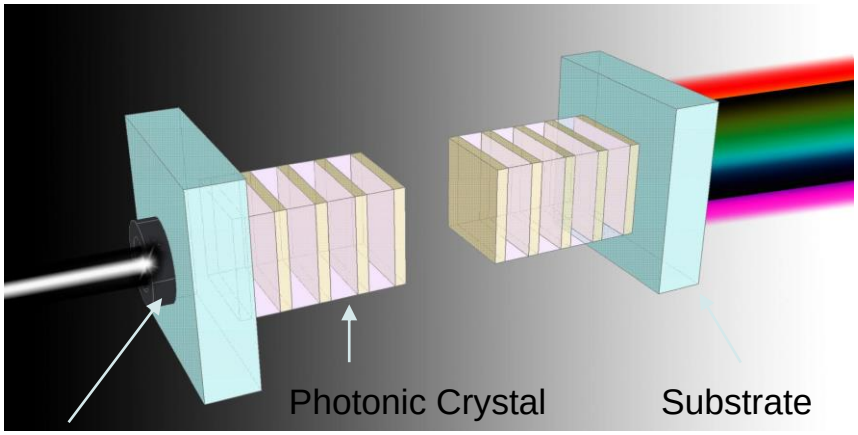


Photonic crystal narrow band filter (Yibiao Yang)

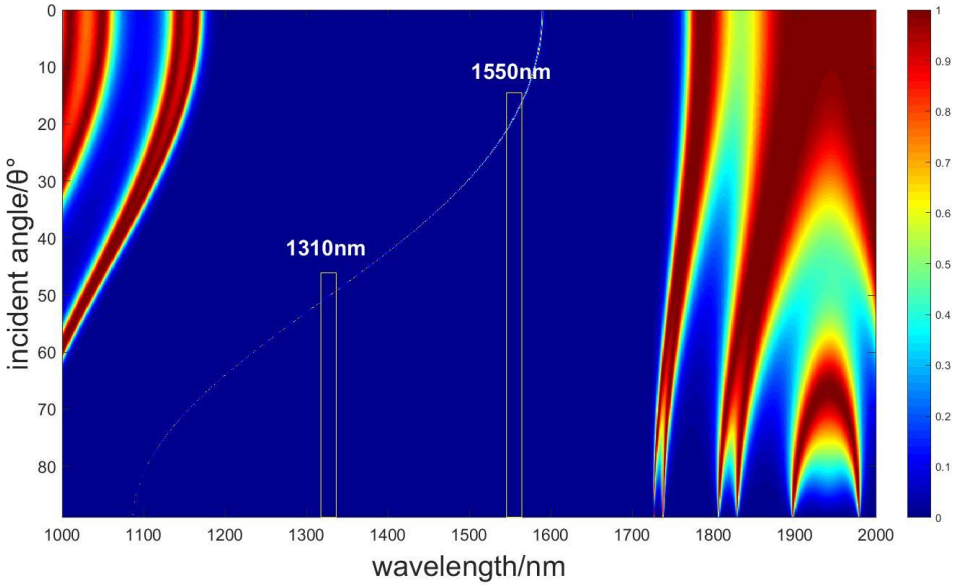
$(Si/SiO_2)_n/Air/(SiO_2/Si)_n$



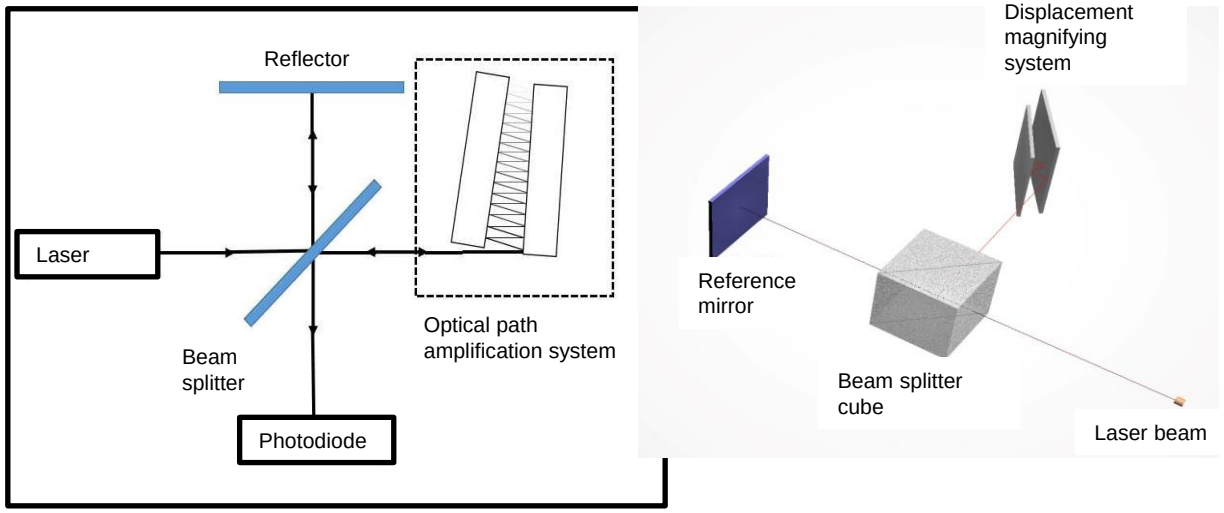




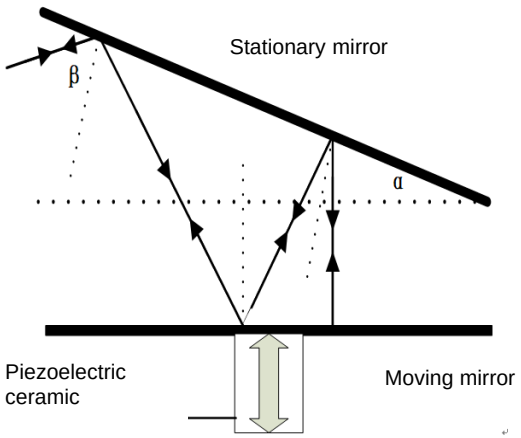
Piezoelectric Ceramics



Piezoelectric ceramic micro-displacement drive(Yibiao Yang)



High precision micro-displacement detection system based on Michelson's interference principle



Optical path amplification device schematic

Piezoelectric ceramics have nonlinear characteristics

↓ ?

nanometer-level positioning accuracy.

Michelson interference principle

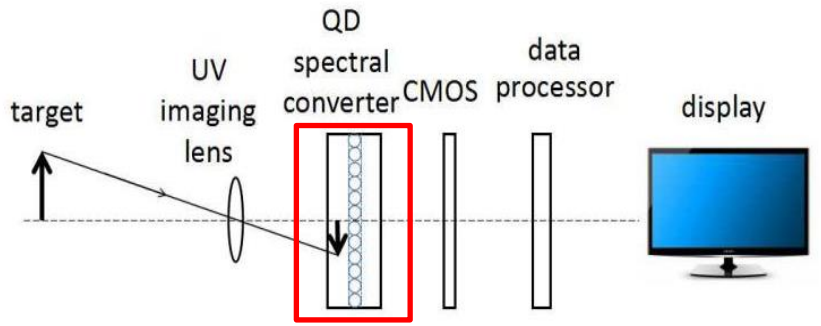
+

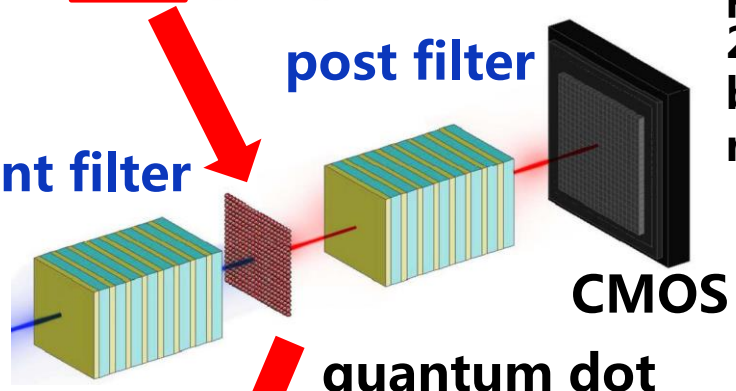
optical path amplification principle

↓

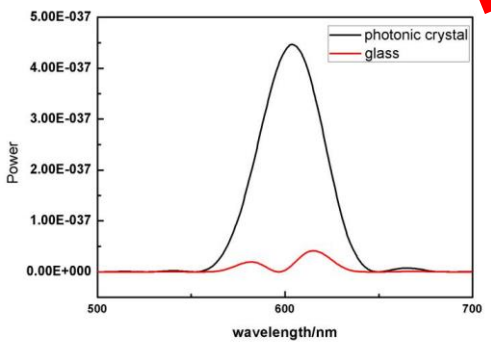
a high-precision micro-displacement detecting device

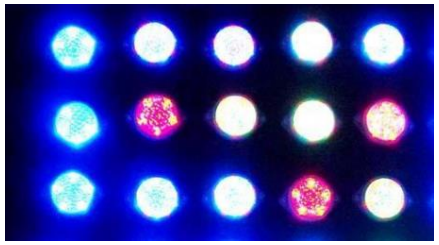
Ultraviolet-visible spectrum converter(Yibiao Yang)



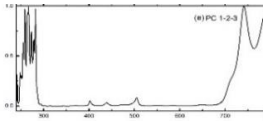


quantum dot

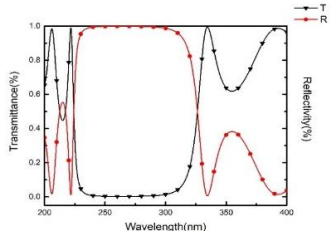




The front filter only allows 240nm-280nm solar blind UV band to pass, the rest is forbidden band



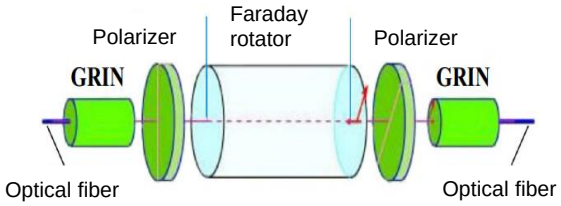
The post filter only prohibits the passage of 240nm-280nm solar blind UV band, and the rest is passband



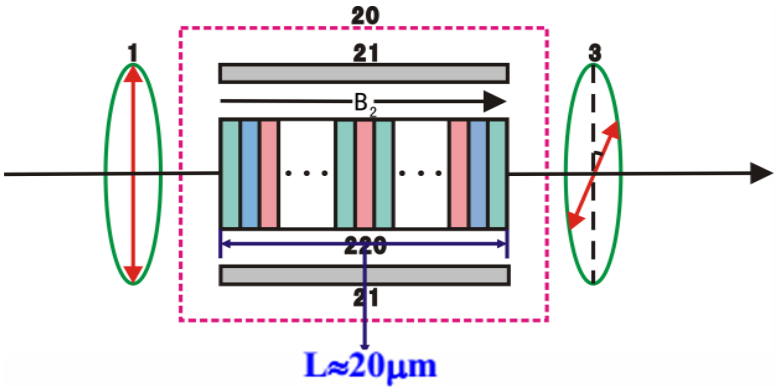
Miniaturization and **high precision** are the future development directions of the solar blind UV imaging system. Based on the principle of quantum dot photoluminescence and one-dimensional photonic crystal, an ultraviolet-visible spectral converter was designed for UV imaging system.

Photonic crystal filter, isolator
Hongming Fei

Optical isolator

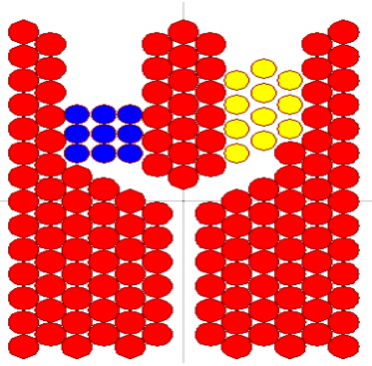


Optical isolator structure



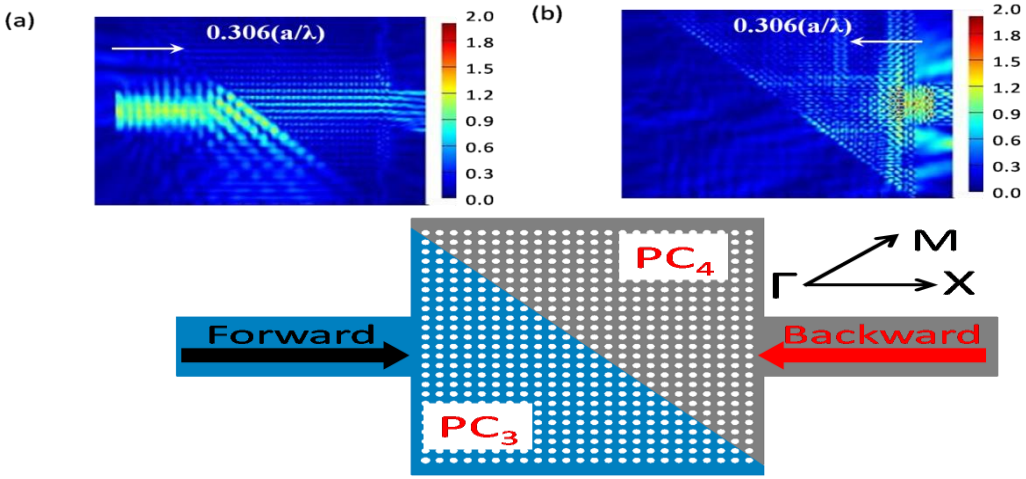
Photonics and Nanostructures–Fundamentals and Applications 17 (2015) 15–21

Polarization multiplexing

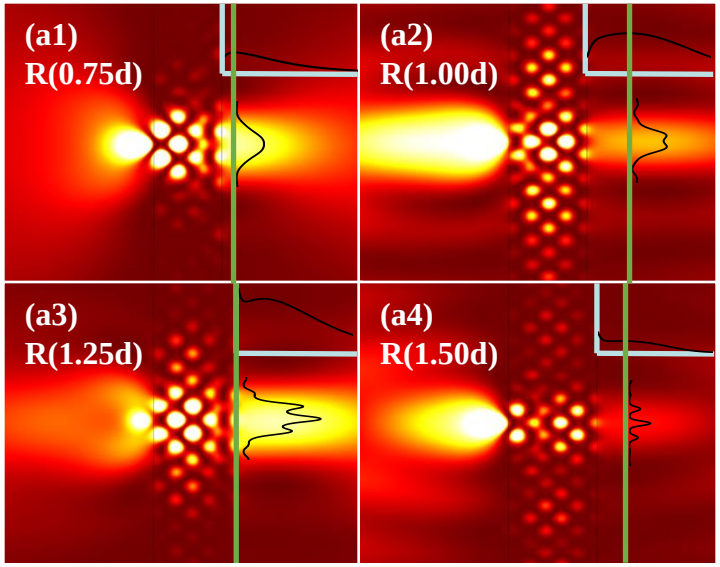


J. Inf. And Mill. Waves 2014, 33(2):154-158

Photonic diode

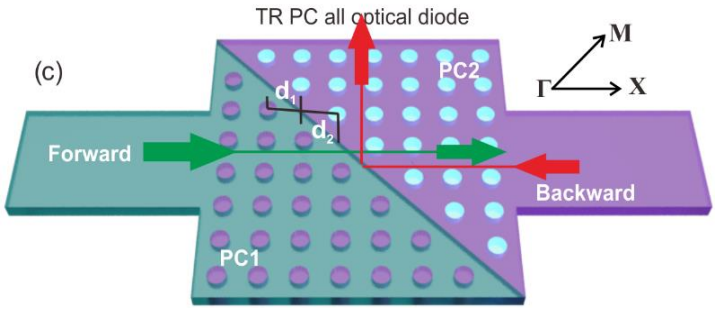


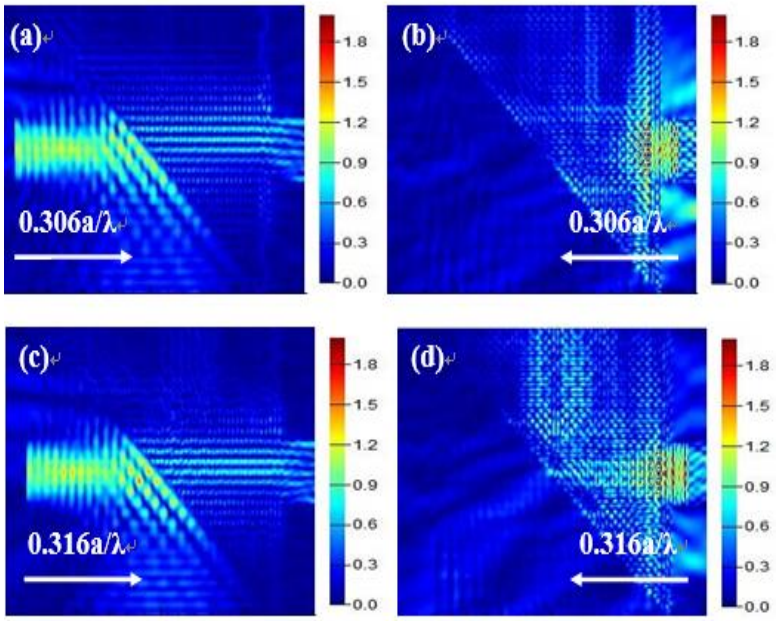
Broadband polarization-insensitive unidirectional transmission in 2D photonic crystals heterostructure based on generalized total reflection principle（2017）

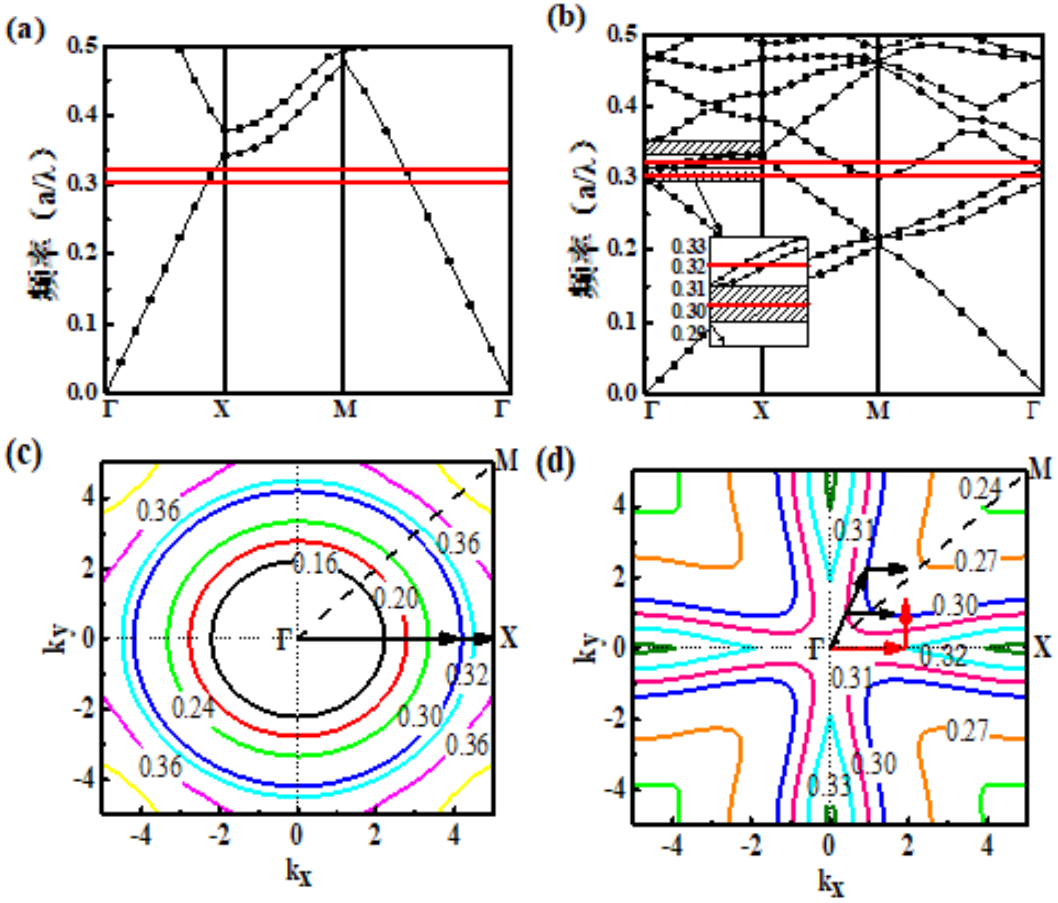


Photonic crystal lens

Photonic crystal all-optical diode realized by generalized total reflection（Hongming Fei）

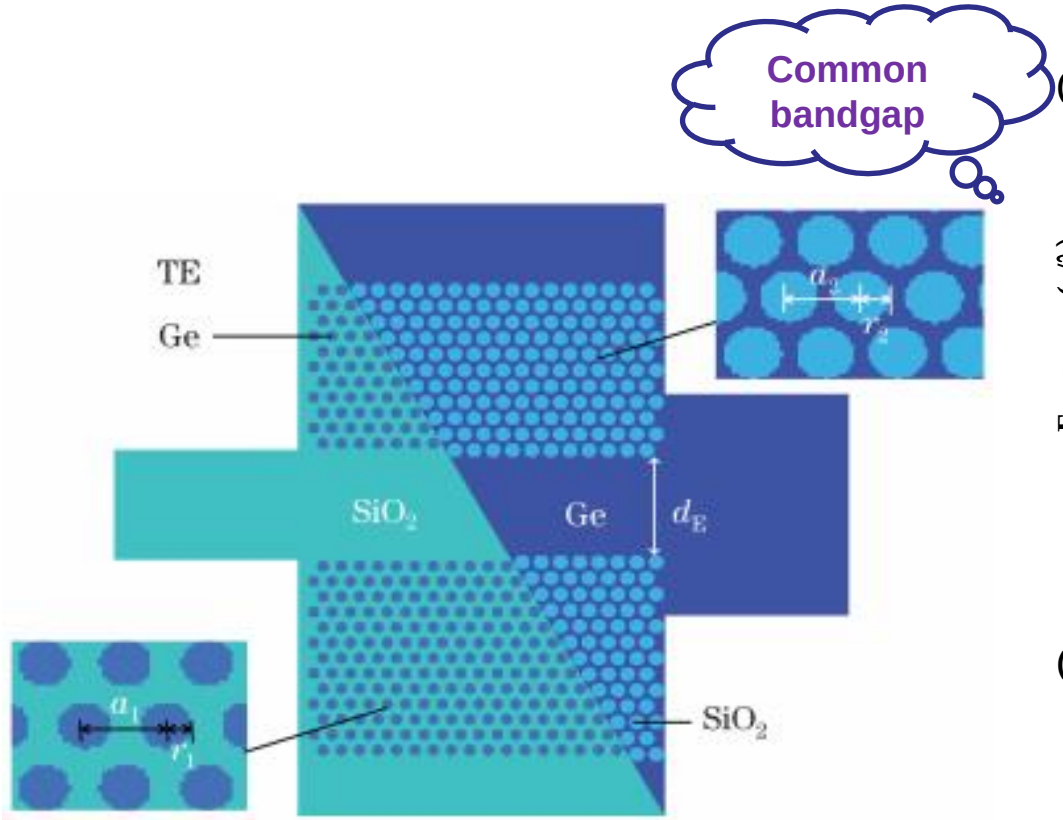


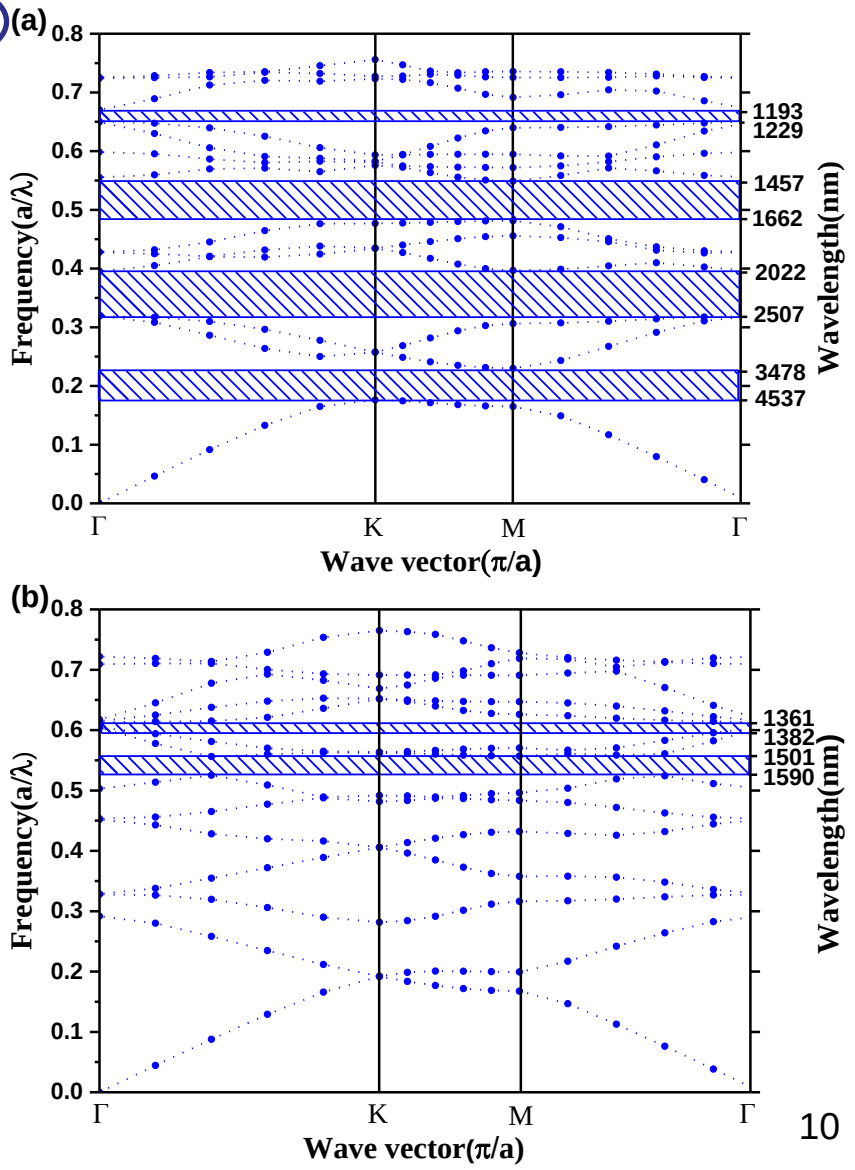




Fei H. M., Xu T., Liu X., et al. Acta Phys. Sin. 66 (2017)

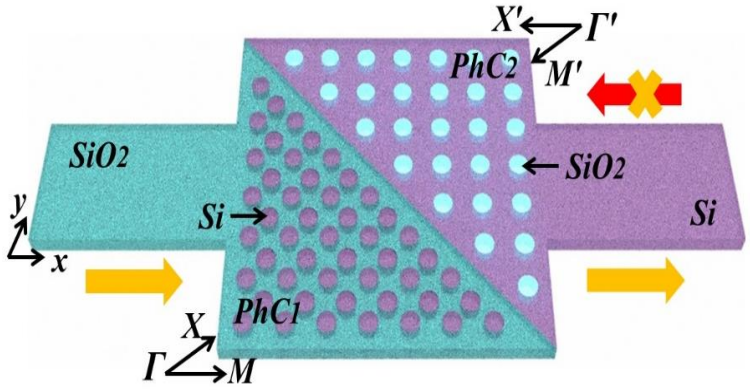
Further increase the forward transmittance through the photonic band gap waveguide（Hongming Fei）

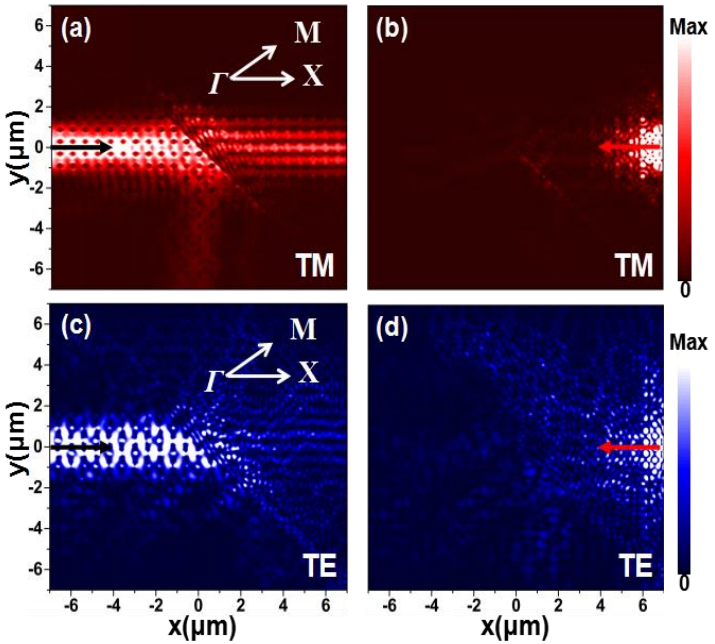


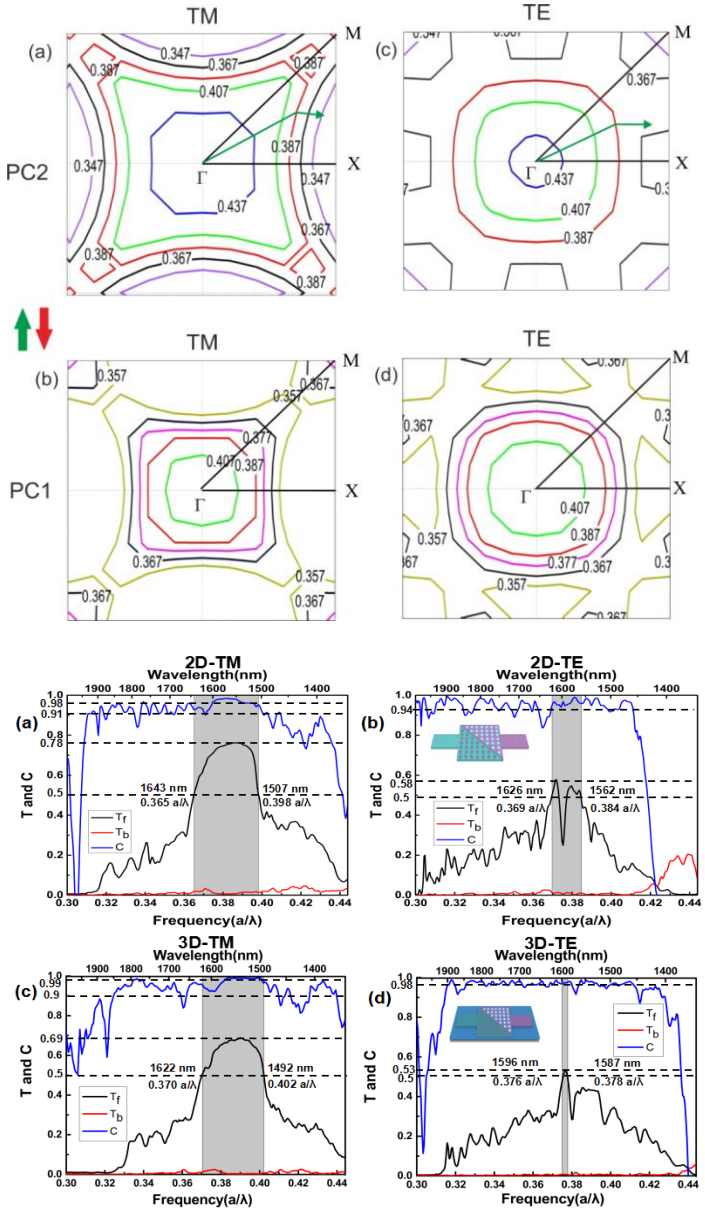


Fei H. M., Wu M., Liu H. Y, et al, Acta Opt. Sin. 38, 0323001(2018).

Polarization-independent reciprocal photonic diode
Hongming Fei



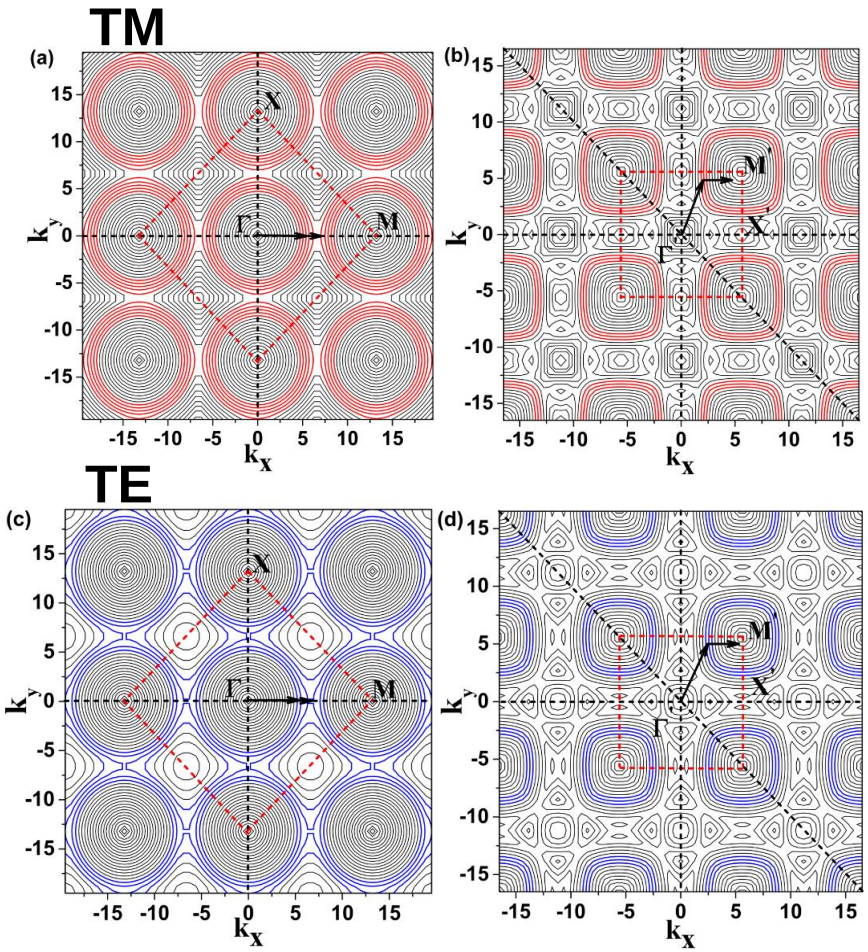


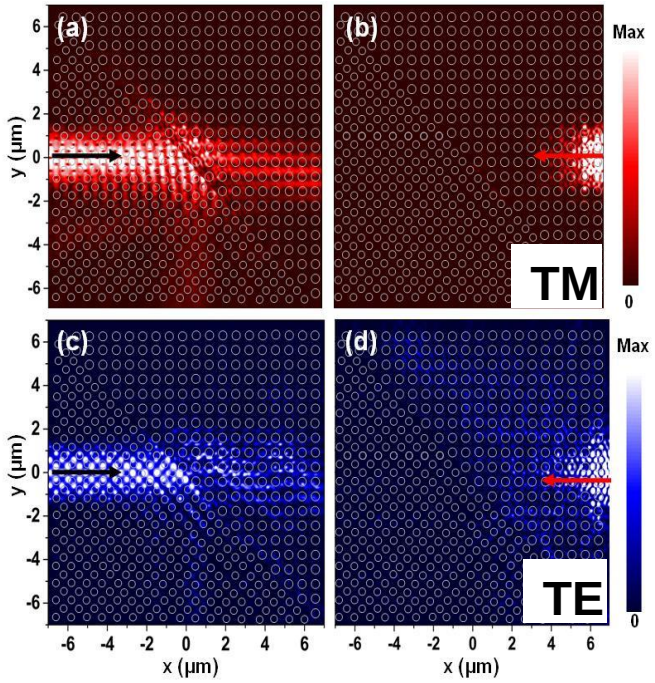


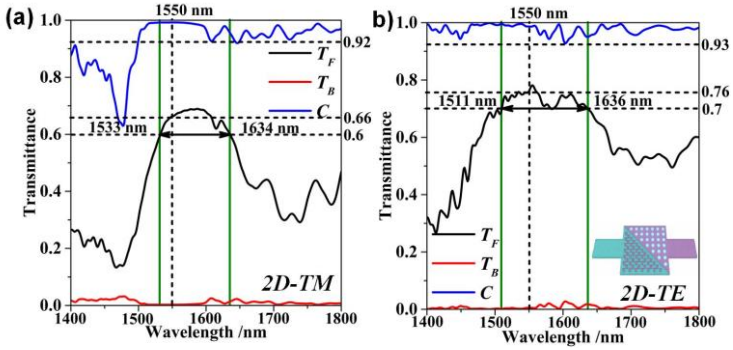
Fei H. M., Wu M., Liu H. Y., et al, Journal of Optics, 2018, 20,095004

Further increase the forward transmittance of the two polarization states（Hongming Fei）

- Field intensity distribution map and equal frequency contour

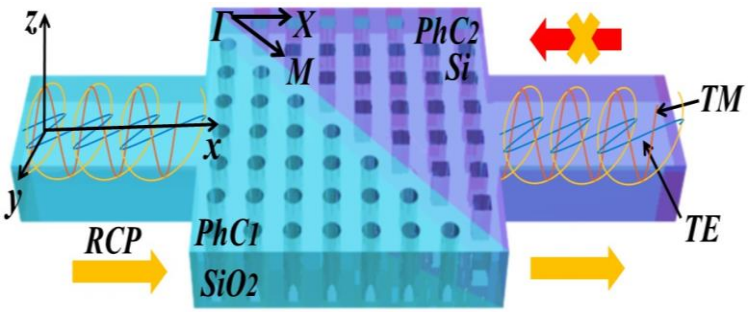


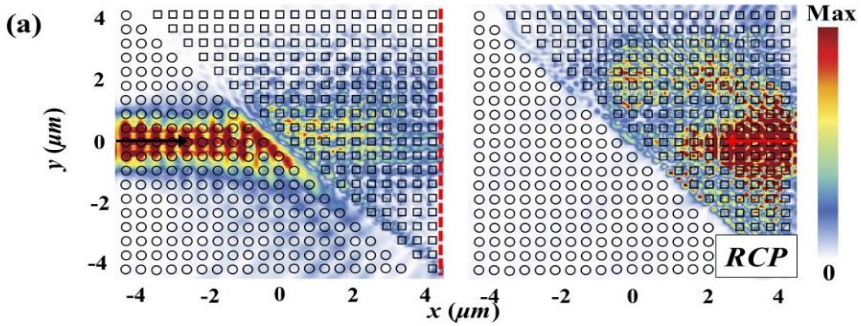


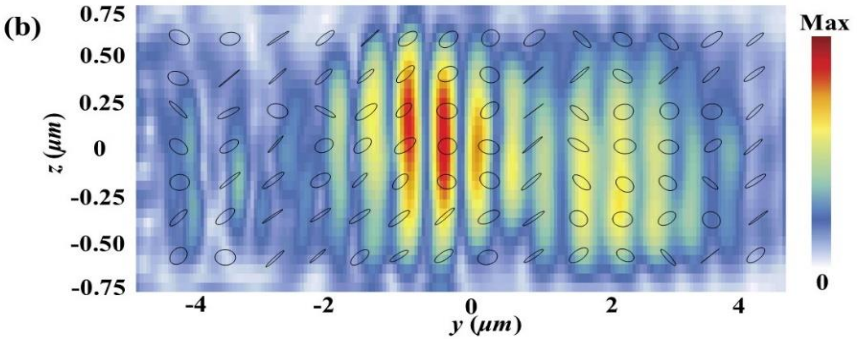


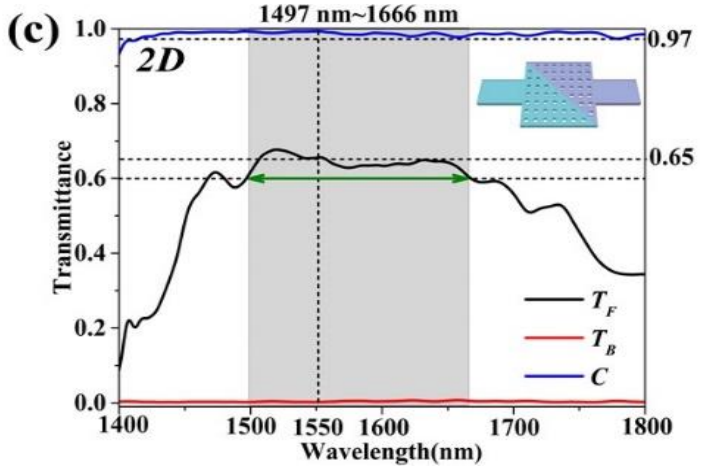
Fei H. M., Wu M., Lin H., et al, Superlattices and Microstructures，2019，132：106155

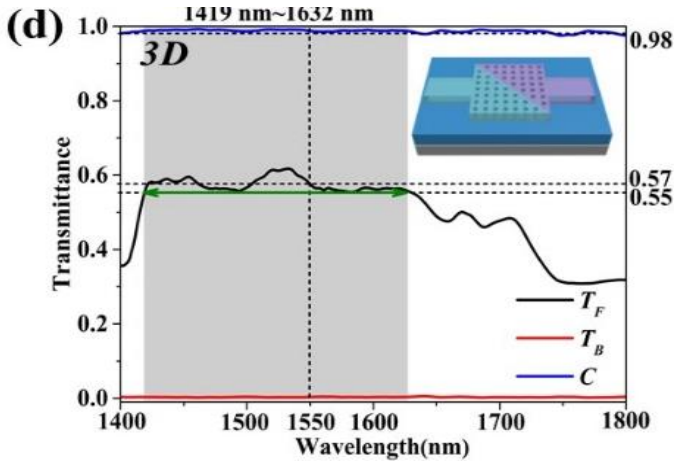
Reciprocating all-optical diode for circularly polarized light (Hongming Fei)





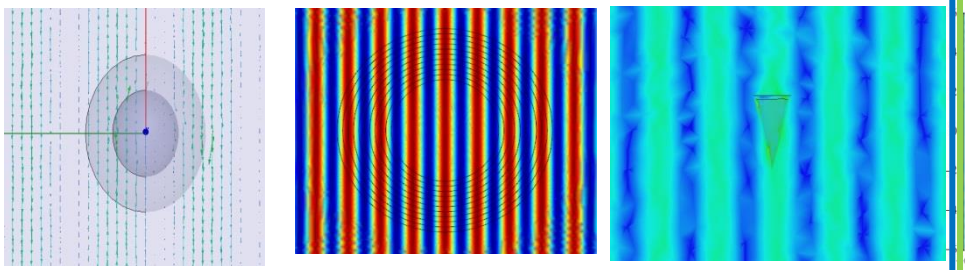




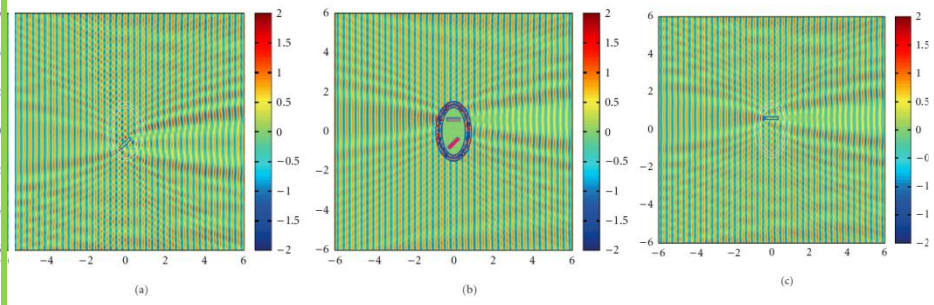


Fei, Hongming, et al. "An on-chip nanophotonic reciprocal optical diode for asymmetric transmission of the circularly polarized light." *Superlattices and Microstructures* (2019): 106155.

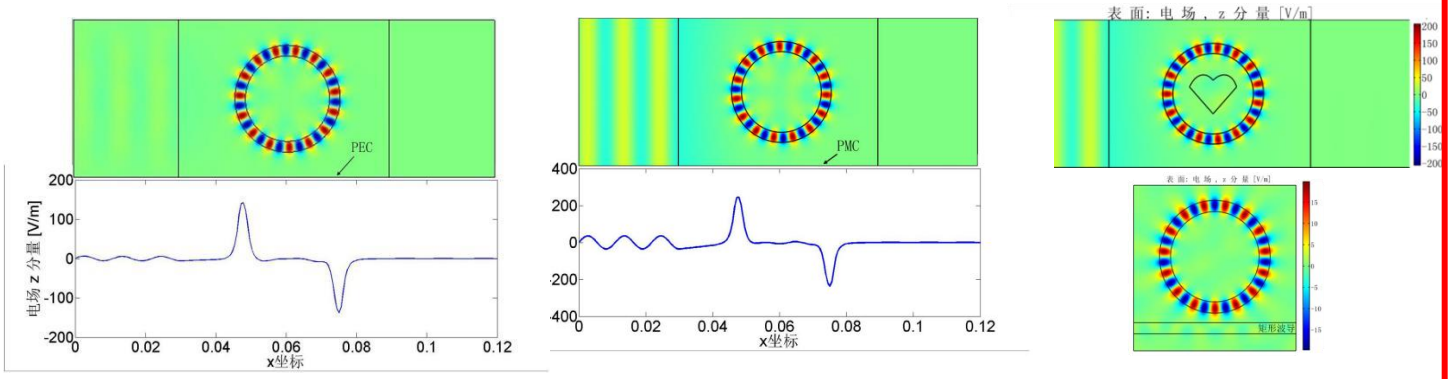
Control Characteristics of Artificial Electromagnetic Materials and Their Sensing Technology (Binzhao Cao)



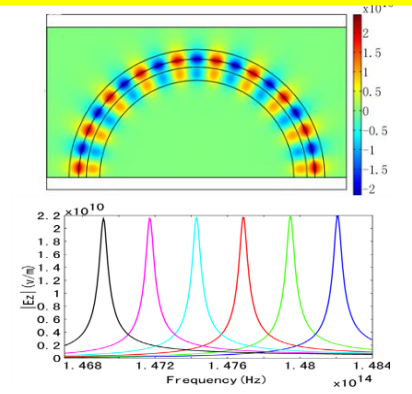
Cloaking and Transparency of Electromagnetic Target with Cladded Metamaterials Based on Scattering Cancelling Theory



Realization of Radar Illusion Using Active Devices



Transmission Characteristics of WGM with Planar Combined Waveguide Based on Metamaterials



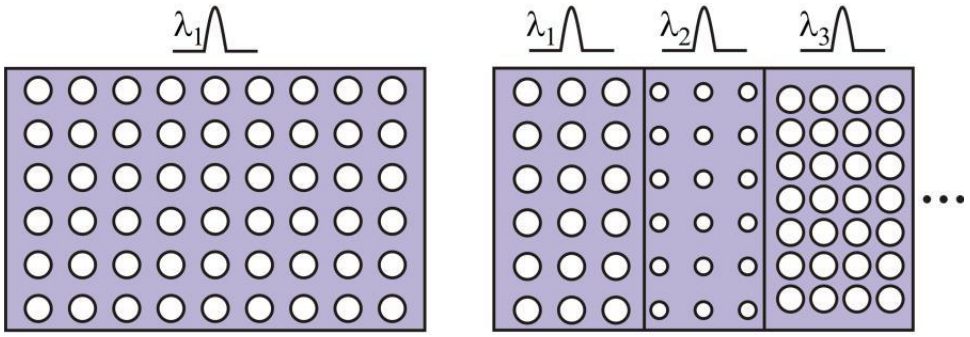
Terahertz sensor based on semi-ring WGM

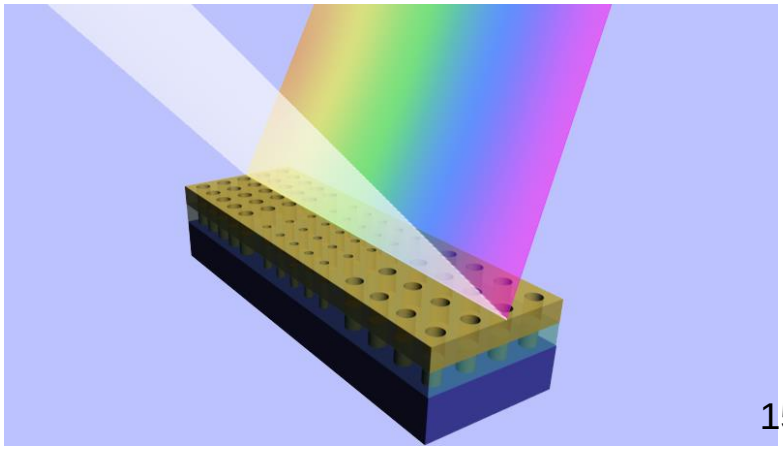
Photonic crystal composite structure enhancing colloidal quantum dot temperature sensing technology（Zhihui Chen）

When the characteristic dimension of functional structures reduces down to the nanometer range, it becomes extremely challenging to measure their temperature using conventional techniques either in the contact or in the noncontact modes due to insufficient spatial resolution[1,2] For example, a thermocouple has a spatial resolution of ~100 μm and a temperature-sensitive paint of ~1 μm.[3,4] Recently, submi-

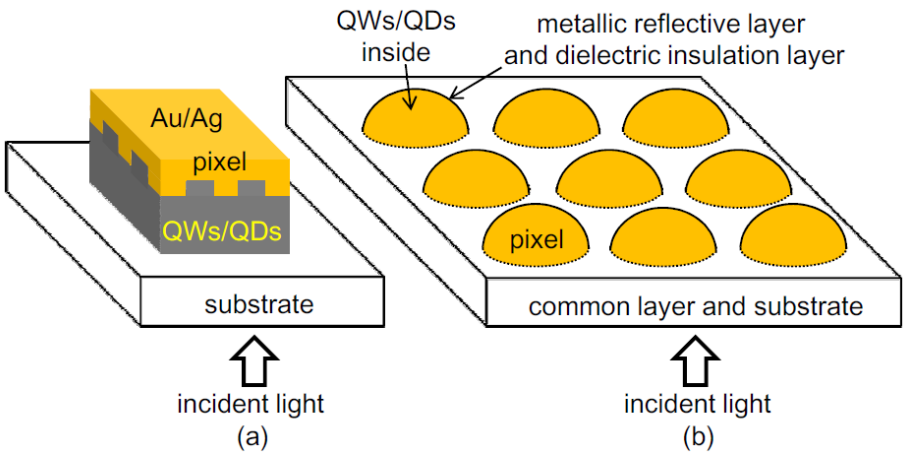
Micro-nano device temperature measurement
Temperature measurement in high electromagnetic interference environment
Distributed temperature monitoring, sensor network

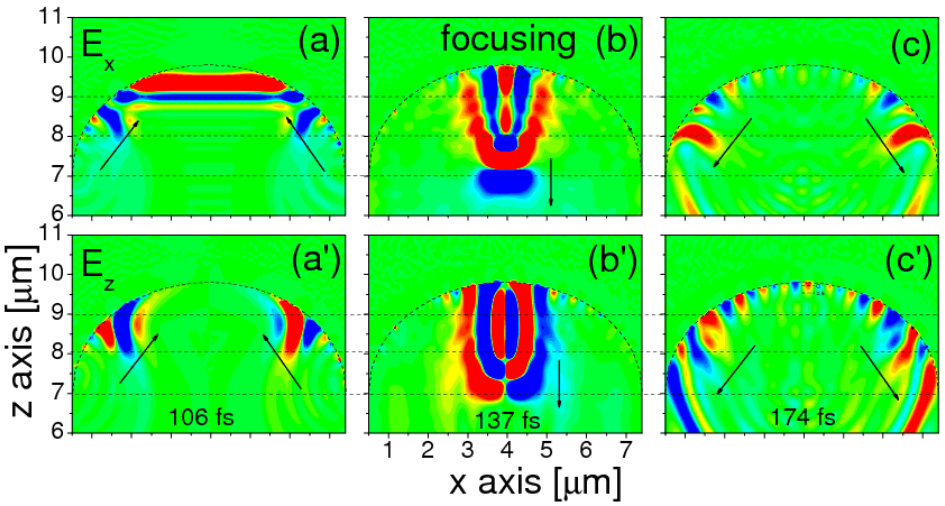
- The micro-nano optical temperature sensor has the advantages of anti-electromagnetic interference, high speed, high sensitivity, low energy consumption, small size and easy integration.
- Micro-nano optical temperature sensors with fluorescent properties can avoid the effects of pressure, humidity, and binder materials.
- The ordinary fluorescent substance has a narrow excitation spectrum, a wide fluorescence emission peak, poor light stability, and low quantum yield.
- Due to the quenching effect, when the temperature is higher than 370K, the fluorescence intensity of the colloidal quantum dots is weak, which is difficult to detect, and directly affects the sensitivity of the colloidal quantum dot temperature sensor in the high temperature range (370-500K).



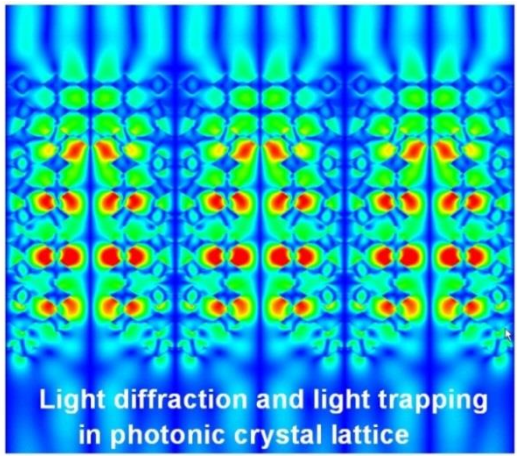


Photonic crystals used in optical modulation technology in photodetectors（Zhihui Chen）

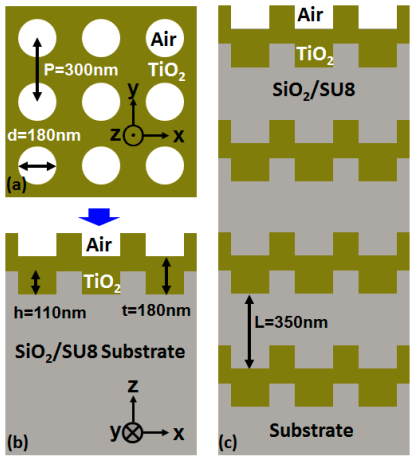


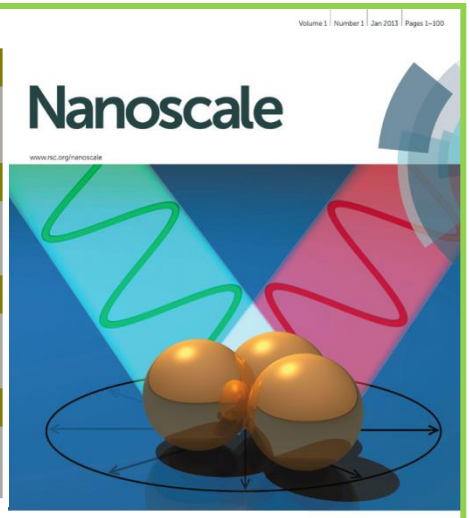


Z. H. Chen, *Appl. Phys. Lett.* 100,043502 (2012)



Z. H. Chen, *Sol. Energ. Mat. Sol. C* 99 316-320 (2012)

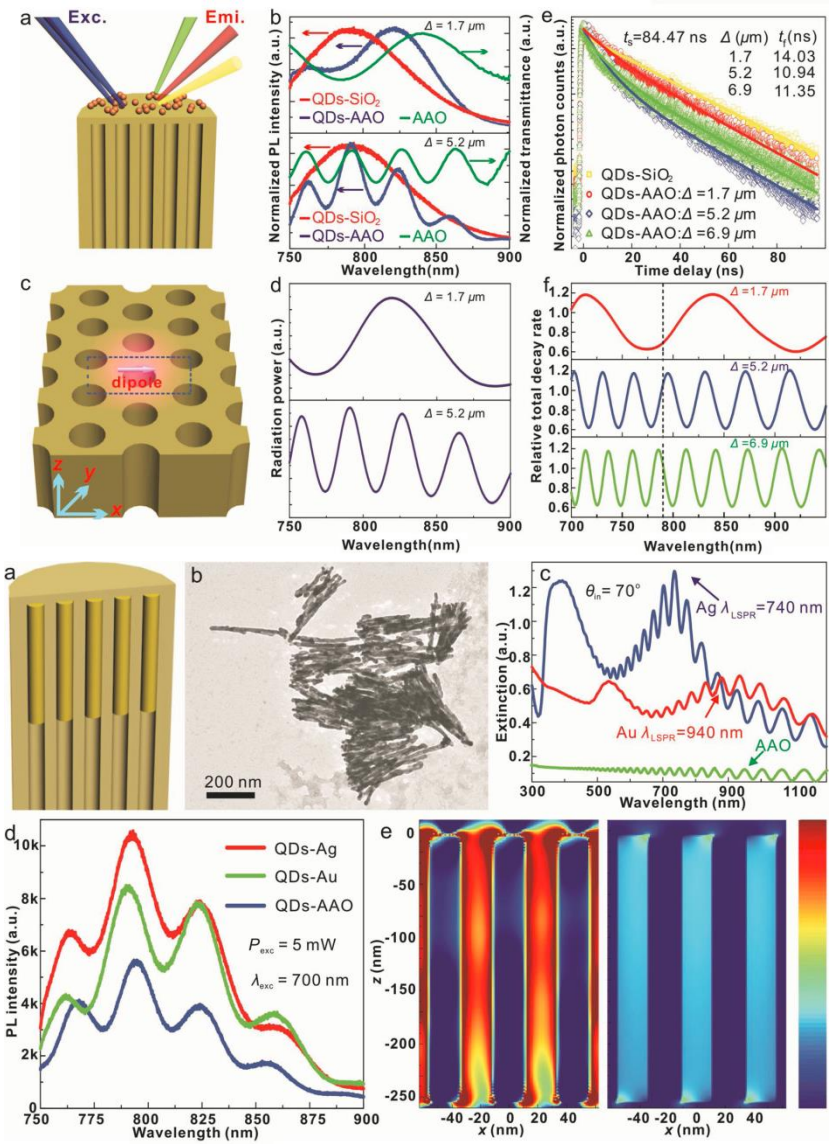




Z. H. Chen, *Nanoscale. Accepted.*

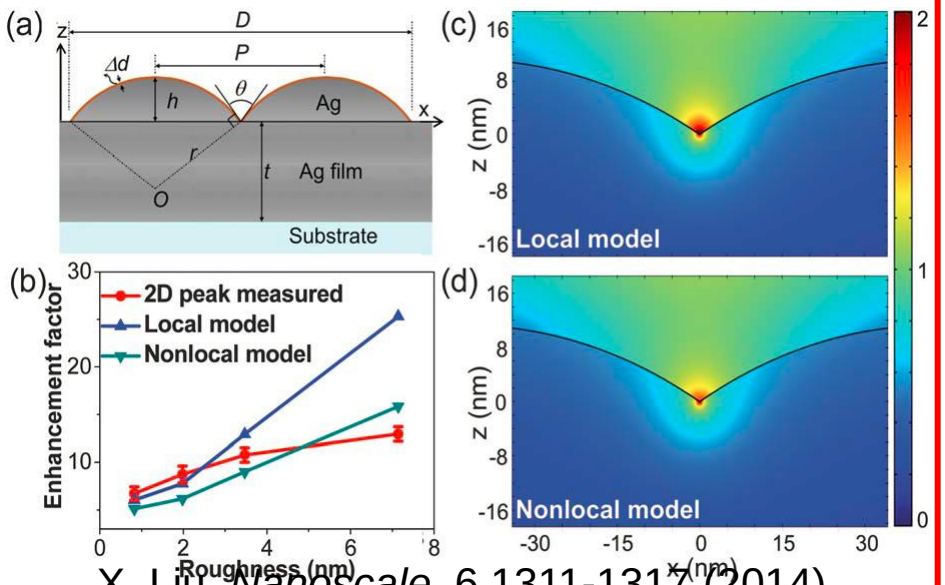
Micro-nano photonic structure enhancing surface plasmon technique（Xin Liu）

Quantum Dots emission shaping



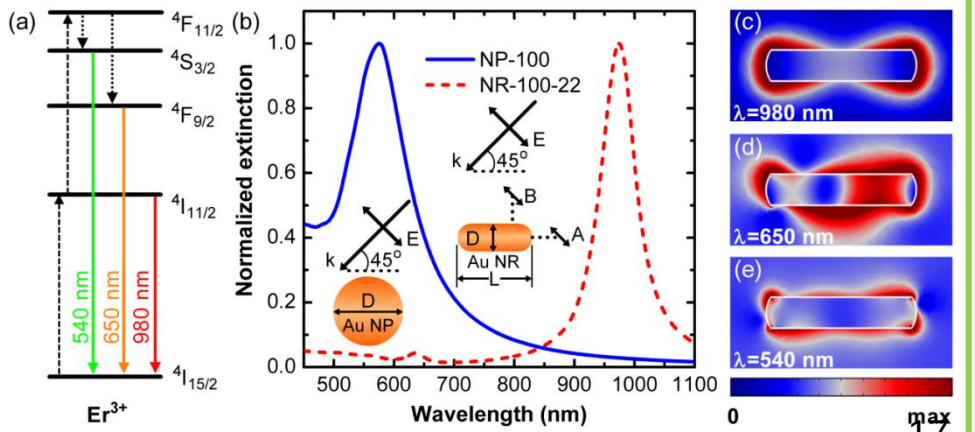
X. Liu. *Adv. Opt. Mate.* 2 56-64 (2014)

Raman of graphene



X. Liu. *Nanoscale.* 6 1311-1317 (2014)

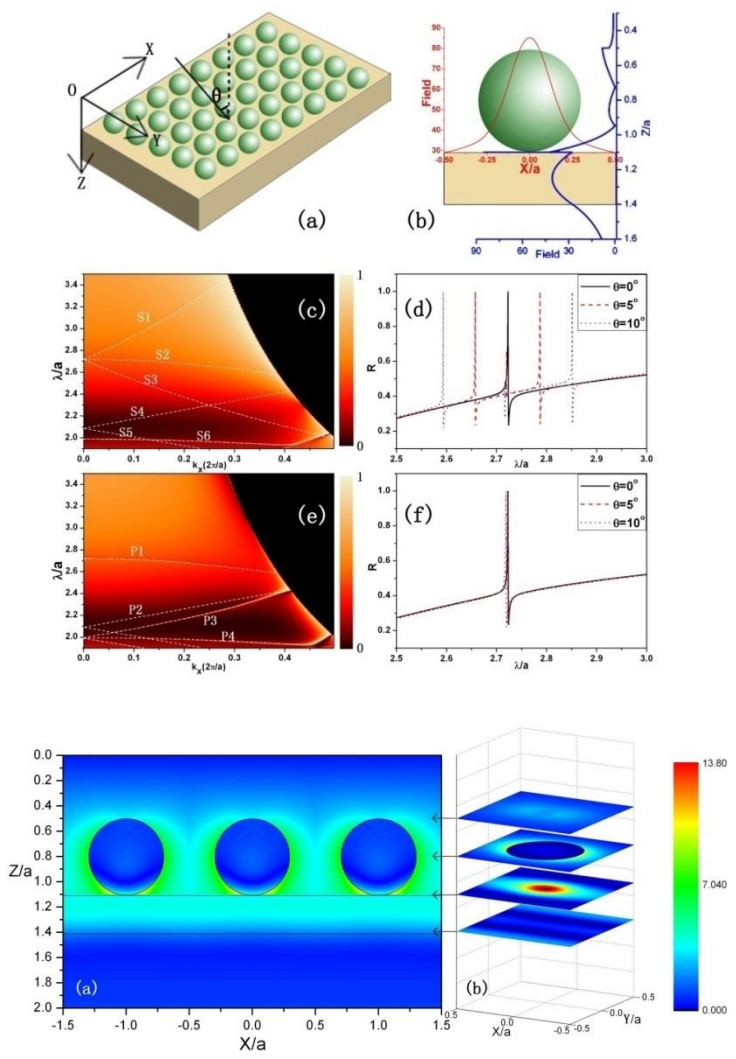
LSP-induced upconversion enhancement



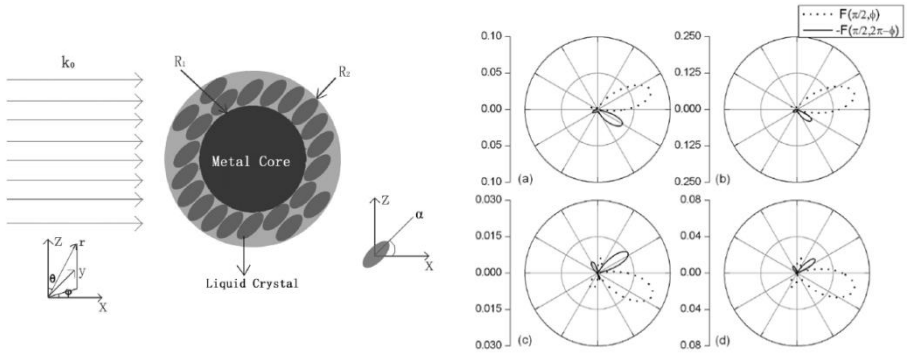
X. Liu. *Sci. Rep. 5 15235 (2015)*

Optical localization and conduction control technology of photonic crystal（Mingda Zhang）

Ultrasensitive optical absorption

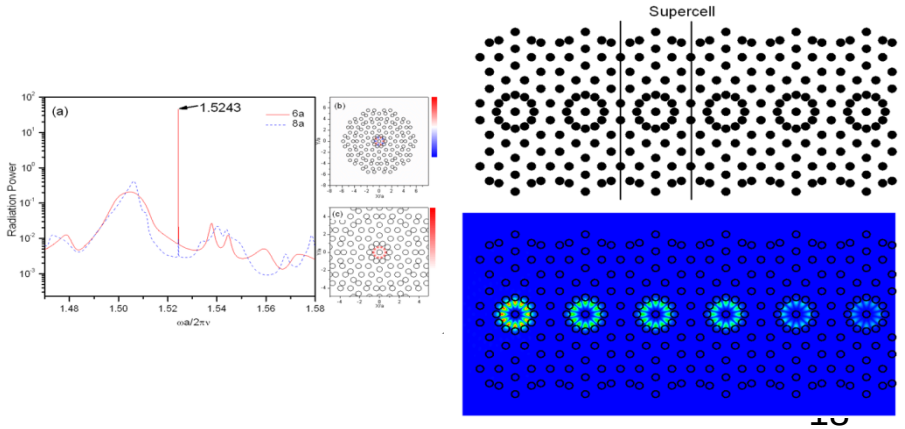


Electric field tunable photonic Hall effect



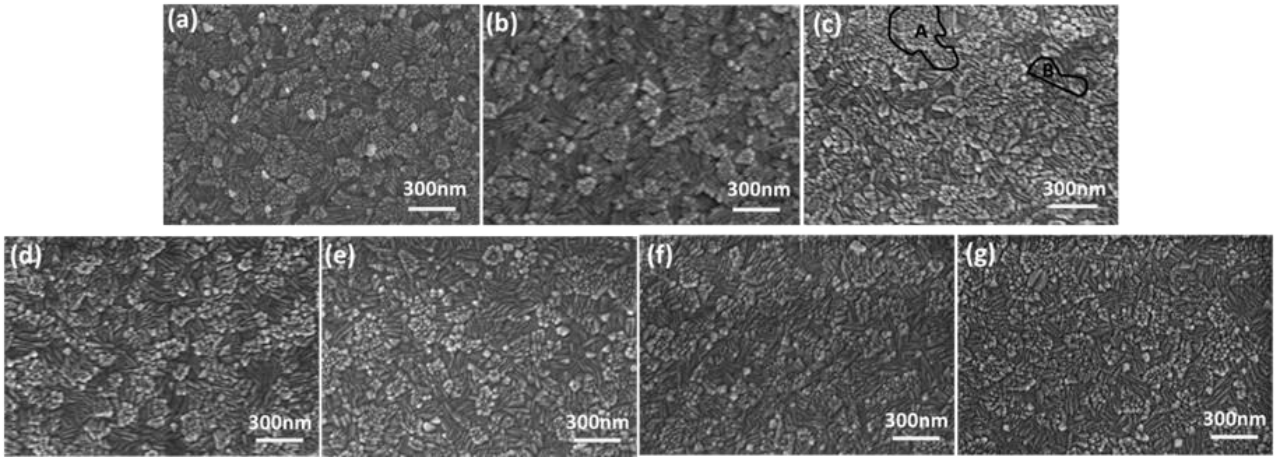
Zhang, M. ***Phys. Lett. A*** 378, 1571–1577(2014)

Defect-free localized modes

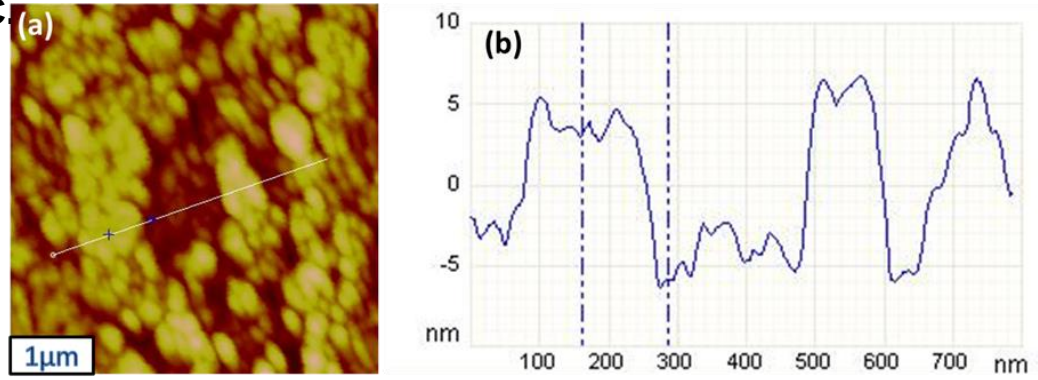


Zhang, M. ***J. Appl. Phys.*** 111, 104314 (2012)

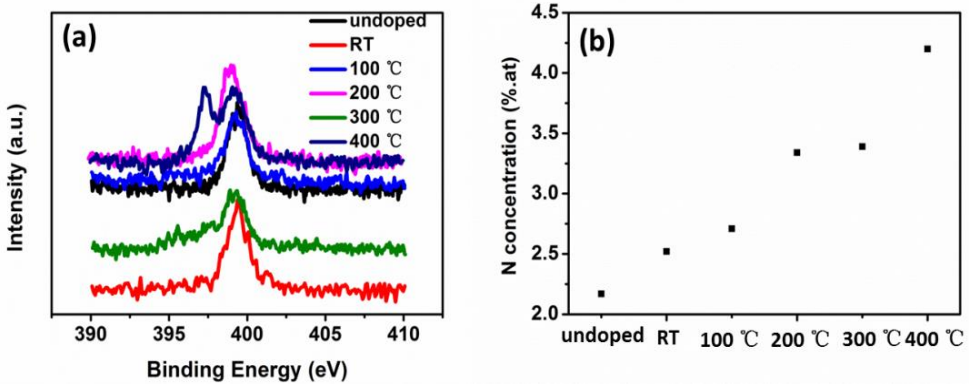
Optical and electrical properties of nitrogen-doped NiO thin films



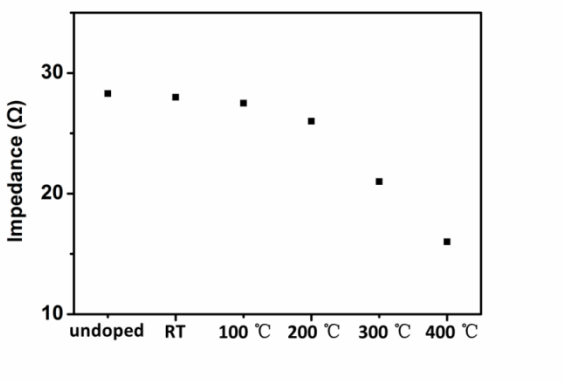
Surface SEM images of (a) ITO, (b) undoped NiO at room temperature and N-doped NiO thin films at (c) room temperature, (d) 100 ºC, (e) 200 ºC, (f) 300 ºC , (g) 400 ºC.



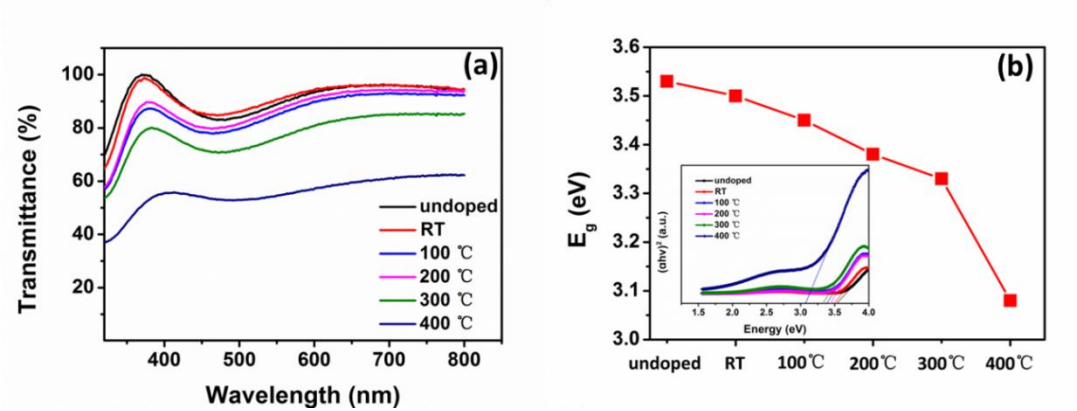
(a) AFM images of N-doped NiO thin films at room temperature and (b) line profile across region A and region B.



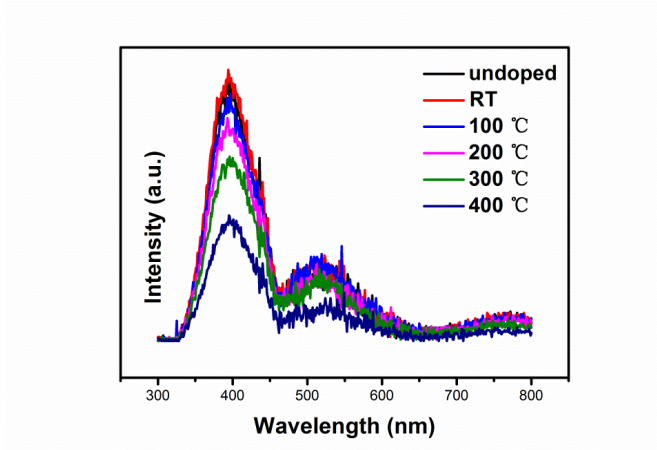
(a) N 1s spectra of NiO thin films and (b) the N content as a function of substrate temperature.



Impedance of samples deposited at different substrate temperature.



(a) UV-Vis transmittance spectra and (b) optical band gap energy of NiO thin films deposited at different substrate temperature.



Room temperature PL spectra of NiO thin films deposited at different substrate temperature.

3. Research Platform - Projects

- A total of 12 projects have been granted, including 6 National Natural Science Foundation of China projects and 6 provincial and ministerial projects.
- More than 2.34 million RMB in total

	Funding source	Project name	Leader	Funding
1	National Natural Science Foundation of China	Optical communication band micro-displacement driven photonic crystal high-precision tunable filter	Yibiao Yang	730 K
2	National Natural Science Foundation of China	Study on the integration of micro/nano-light coupling structure to improve the luminous efficiency of upconverting nanoparticles	Zhihui Chen	700 k
3	National Natural Science Foundation of China	Two-dimensional silicon photonic crystal composite structure improves high temperature sensitivity of colloidal quantum dot temperature sensor	Zhihui Chen	280 K
4	National Natural Science Foundation of China	Near-field enhancement of plasmon surface of metal nanostructures under non-localized effects	Xin Liu	200 K
5	National Natural Science Foundation of China	Study on tunable filtering characteristics of one-dimensional photonic crystals with single air defect cavity	Yibiao Yang	180 K
6	National Natural Science Foundation of China	Theoretical study on unidirectional transmission of light wave by left-handed medium photonic crystal	Hongming Fei	40 K
	National Natural Science Foundation of China	Research on photonic crystal structure based on topology for unidirectional optical wave transmission	Mingda Zhang	250 K
7	Shanxi Natural Science Fund Project	Numerical study of super large complete band gap photonic crystals in visible and infrared bands	Yibiao Yang	50 K
8	Shanxi Natural Science Fund Project	Micro-nano-optical coupling structure of high-efficiency infrared life detector for mine	Zhihui Chen	30 K
9	Shanxi Natural Science Fund Project	Asymmetric guided mode resonant grating enhances broad spectrum optical absorption efficiency of organic solar cells	Xin Liu	30 K
10	Shanxi Natural Science Fund Project	Theoretical study of left-handed media embedded optical band photonic crystal optical isolator	Hongming Fei	40 K
11	Shanxi Natural Science Fund Project	Theoretical study on the application of total reflection to photonic crystal heterostructure for unidirectional transmission of light waves	Hongming Fei	40K
12	Shanxi Natural Science Fund Project	Reducing the effect of disordered perturbation on optical communication band photonic crystal filters	Mingda Zhang	20 K

3. Research outcomes - papers and patents

- Published more than 140 academic papers, including 93 in SCI and 16 in EI

- Granted 6 national inventive patents, and applied for more than 10 patents

3. Research Platform - Experimental Platform

●**Supporting platform:**

Shanxi Key Laboratory of New Sensors and Intelligent Control Ministry of Education

School of Physics and Optoelectronic Engineering

●**Device fabrication system**

High vacuum magnetron sputtering instrument (Shenyang Science and Technology JGP-450B)

●**Device characterization system**

Fluorescence spectrometer (Edinburgh FS5), spectrophotometer (Photo Research PR-65), atomic force microscope (Japan Shimadzu SPI3800), optical power meter (Newport 1830 C), digital source meter (KEITHLEY 2400), etc.

● **Chemical synthesis equipment**

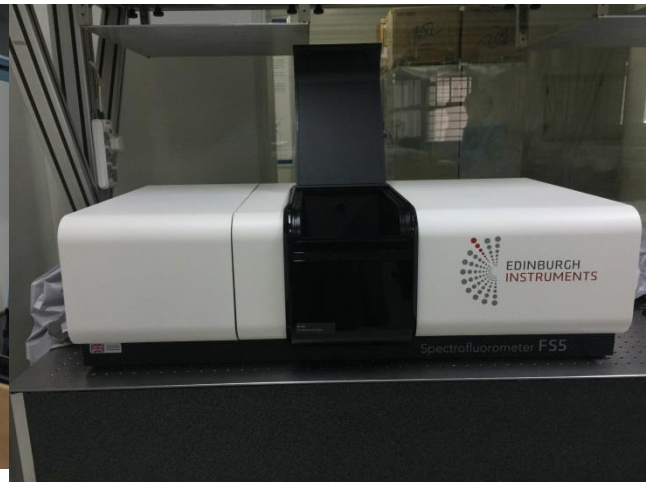
Fume hood, spin coater (Shenyang Sile TC-108),

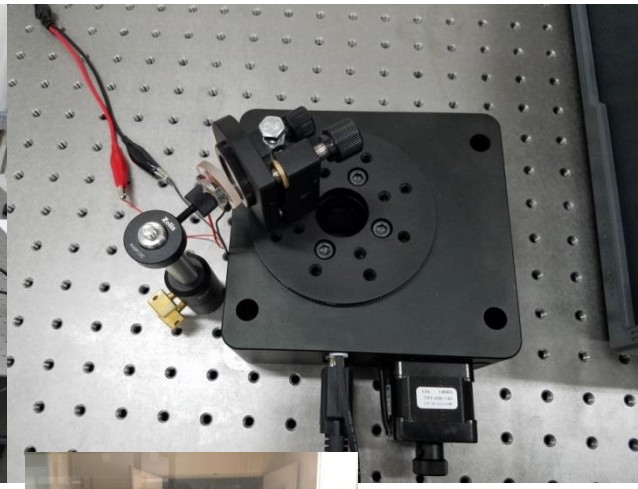
Drying oven, electronic scale, etc.

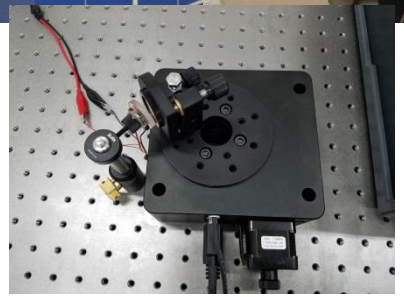
Institute of Measurement and Control Technology

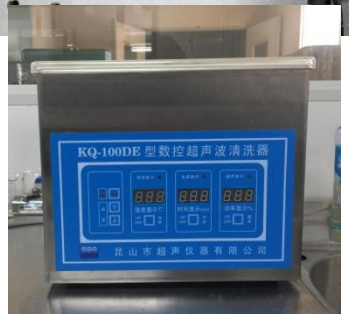

Physics building

3. Research platform - Experimental equipment



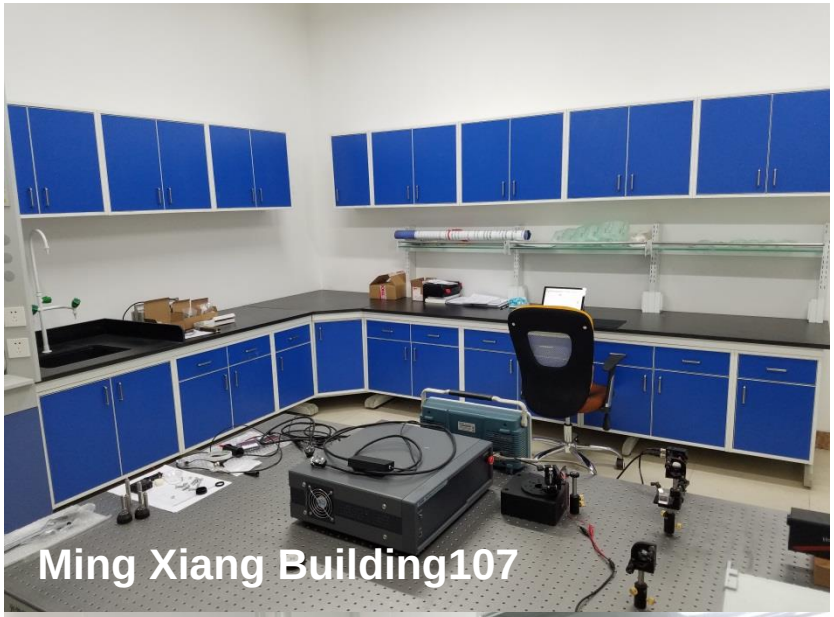






3.Research platform - Research environment

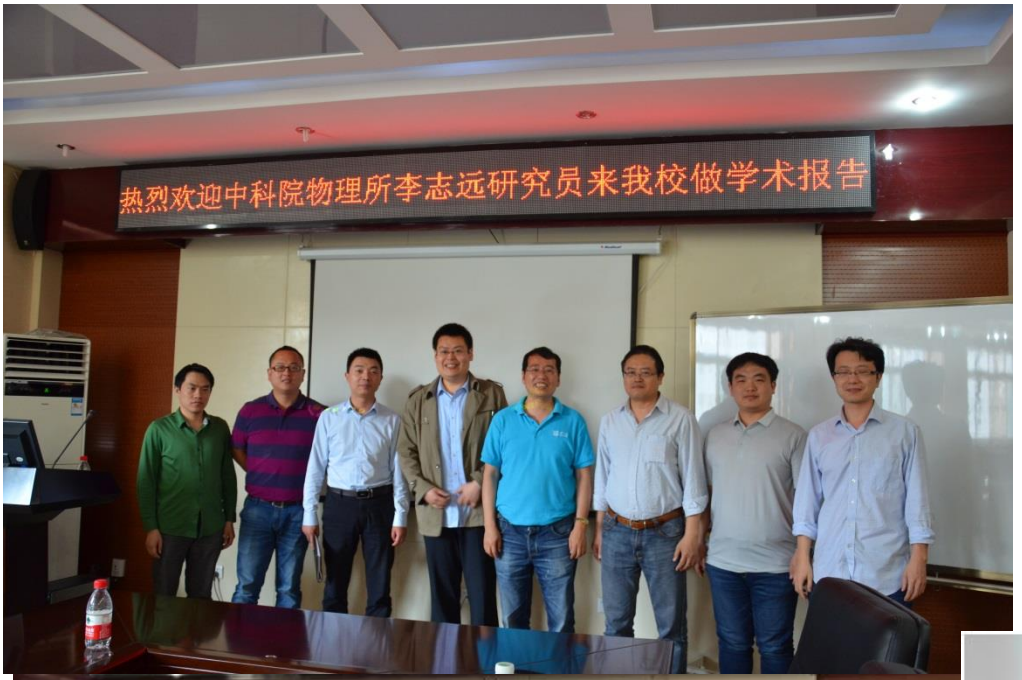

Ming Xiang Building 408


Ming Xiang Building107

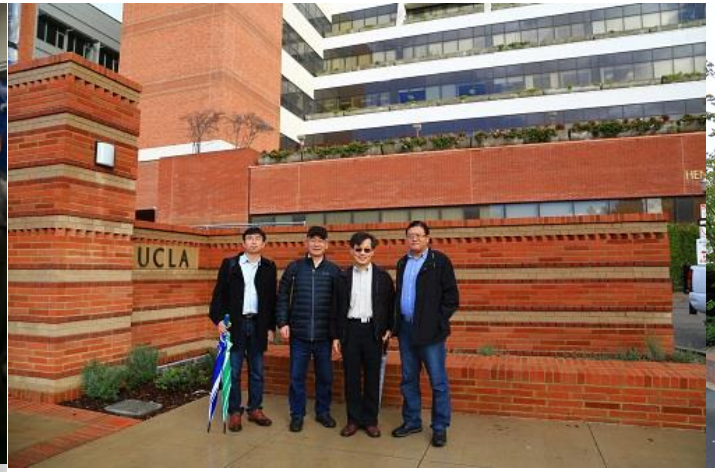

Institute of Measurement and Control Technology 301

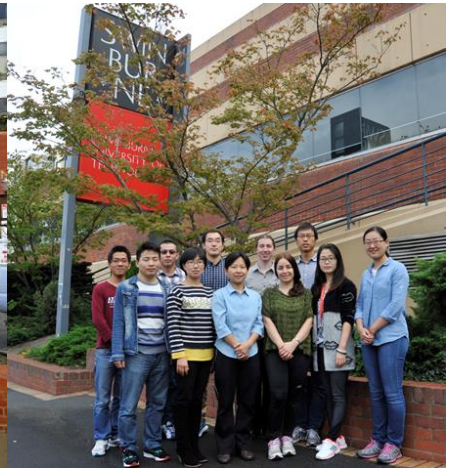

Institute of Measurement and Control Technology Level 1

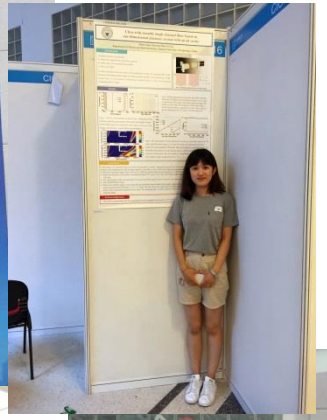
4. Academic exchange - Expert visit



4. Academic exchanges - Academic conferences and Visiting







5. Students

Thanks for your consideration