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Optical trapping via guided resonance modes in a Slot-Suzuki-phase photonic crystal lattice

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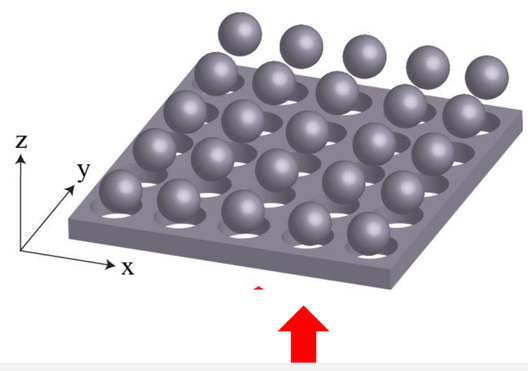
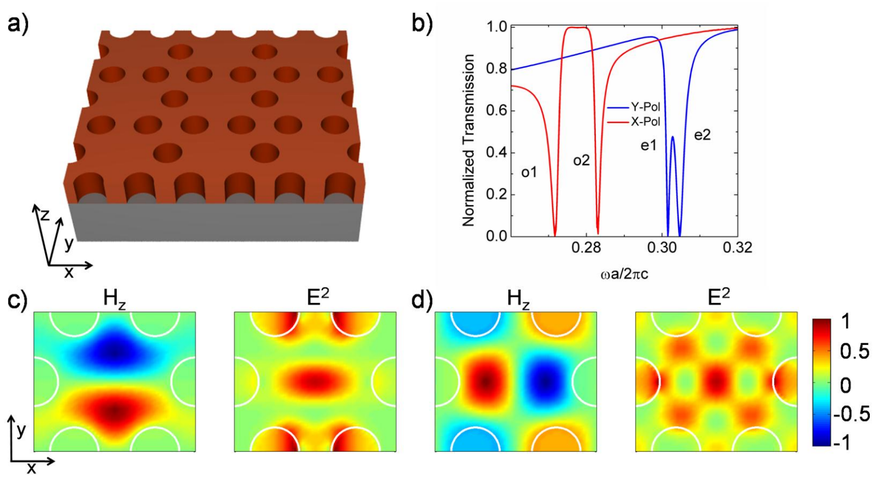
Introduction

- Light-assisted templated self assembly: trap two-dimensional arrays of particles with particular, designable patterns by guided resonances in photonic crystals
- Lower trapping power:
  1) Enhance optical field concentration
  2) Enhance quality factor
  3) Increase coupling power



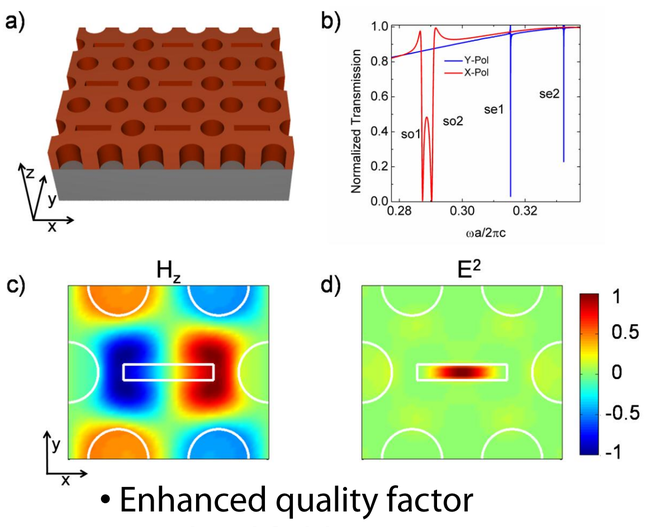
Trapping device

Suzuki-phase lattice



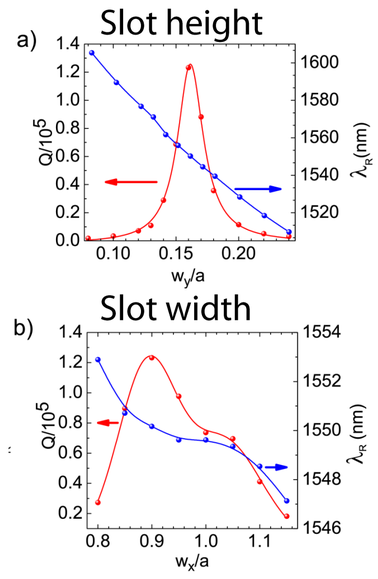
- Low quality factor
- Expanded field distribution

Slot-Suzuki-phase lattice



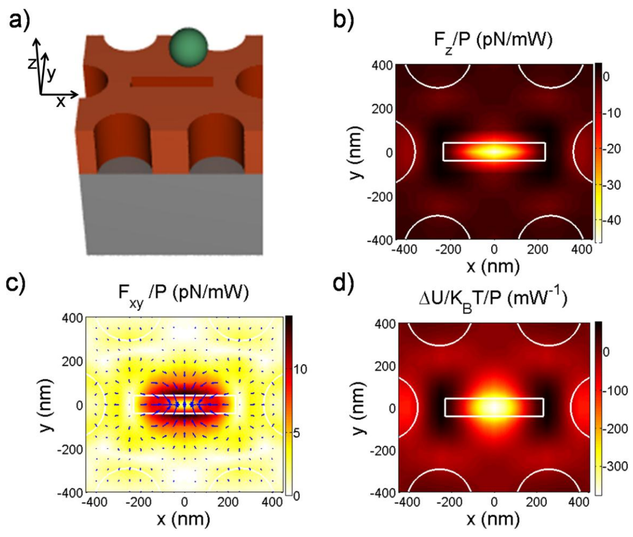
- Enhanced quality factor
- Localized field

Slot effect

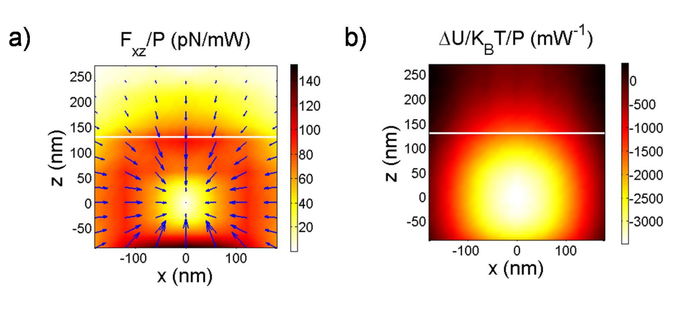


Optical force

Trapping above slot

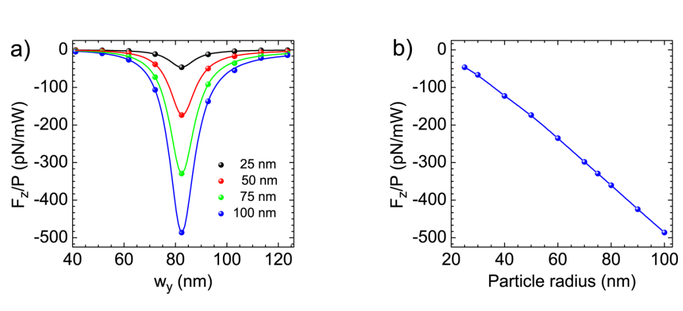


Trapping within slot



- Stable trapping: $\Delta U/K_BT \geq 10$
- Above slot: minimum power of 27 μW per unit cell
- Within slot: minimum power of 3 μW per unit cell

Force dependence



- Force tuned by slot design
- Force enhanced by bigger particles

Conclusion

- A novel device for carrying out light-assisted templated self assembly processes
- Quality factor enhanced by orders of magnitude
- A reduction of optical power by about 40 times relative to our previous work

References

1. C. A. Mejia, A. Dutt, and M. L. Povinelli, Opt. Express 19: 11422-11428 (2011).
2. J. Ma, L. J. Martínez, and M. L. Povinelli, Opt. Express 20: 6816-6824 (2012).

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