Editorial

Optical microcavities confine light to small volumes for a long time, which significantly enhances light-matter interaction. In recent decades, higher quality factor (Q) and smaller mode volume (V_m) cavities have been fabricated, contributing a major role in various studies ranging from fundamental physics to functional photonics devices. For example, microcavity optomechanics, which focuses on coupling an optical field and a mechanical motion, provides an ideal platform for exploring the quantum nature of macroscopic objects [1]; microcavities with deformed boundaries can act as open billiard systems to test classical and quantum chaos [2]; and microcavity-enhanced optical sensors possess ultrahigh sensitivities with the detection limit down to single nanoscale particles [3,4]. Researchers have participated extensively in both theoretical and experimental studies of microcavity photonics, and thus making the contribution of China prominent in this field of research. Based on these facts, the editorial board of *SCIENCE CHINA Physics, Mechanics & Astronomy* has invited a series of reviews and original works for this special issue. However, because of the page limitation, only a partial account of the progress made in the field of “microcavity photonics”, consisting of two reviews and seven original papers (three theoretical papers and four experimental works), is presented.

The first review focuses on the three-dimensional fabrication of whispering-gallery-mode (WGM) microcavities using femtosecond lasers, which can be applicable to both passive and active cavities with various kinds of materials, at ultrahigh precision [5]. The second review provides a brief introduction on photonic-crystal cavities with promising applications in integrated optical devices [6]. The three theoretical papers are mainly related to mode properties of WGM microcavities. In ref. [7], optical manipulation in optofluidic microbubble resonators is discussed. The study of mode characteristics of a silver-coated silica microdisk in the shape of an inverted wedge is presented in ref. [8]. Improving the chirality of WGMs near the avoided resonance crossing is explored in ref. [9]. In the four experimental articles, the ultralow-threshold lasing in doped WGM microcavities on a chip [10], the characteristics of lasers in a microsquare resonator with a vertex output waveguide [11], the second-harmonic generation in a high- Q WGM microcavity fabricated using femtosecond laser micromachining [12], and the PDMS WGM resonators with strain tuning [13] are discussed.

In summary, optical microcavities with a large figure of merit Q/V_m hold great potential for a wide range of applications. We anticipate this special issue will promote communication among researchers and result in significant progress in the future.

Prof. XIAO YunFeng and GONG QiHuang
Peking University

- 1 Liu Y C, Xiao Y F. Macroscopic mechanical systems are entering the quantum world. *Nat Sci Rev*, 2015, 2: 9
- 2 Cao H, Wiersig J. Dielectric microcavities: Model systems for wave chaos and non-Hermitian physics. *Rev Mod Phys*, 2015, 87: 61–111
- 3 Li B B, Clements W R, Yu X C, et al. Single nanoparticle detection using split-mode microcavity Raman lasers. *Proc Natl Acad Sci USA*, 2014, 111: 14657–14662
- 4 Ozdemir S K, Zhu J, Yang X, et al. Highly sensitive detection of nanoparticles with a self-referenced and self-heterodyned whispering-gallery Raman microlaser. *Proc Natl Acad Sci USA*, 2014, 111: E3836–E3844
- 5 Xu H L, Sun H B. Femtosecond laser 3D fabrication of whispering-gallerymode microcavities. *Sci China-Phys Mech Astron*, 2015, 58: 114202
- 6 Gan L, Li Z Y. Photonic crystal cavities and integrated optical devices. *Sci China-Phys Mech Astron*, 2015, 58: 114203
- 7 Wang H T, Wu X. Optical manipulation in optofluidic microbubble resonators. *Sci China-Phys Mech Astron*, 2015, 58: 114206
- 8 Bo F, Wang X O, Li Y, et al. Mode characteristics of silver-coated inverted-wedge silica microdisks. *Sci China-Phys Mech Astron*, 2015, 58: 114207
- 9 Song Q H, Gu Z Y, Zhang N, et al. Improvement of the chirality near avoided resonance crossing in optical microcavity. *Sci China-Phys Mech Astron*, 2015, 58: 114210
- 10 Fan H B, Jiang X S, Ding Y, et al. Demonstration of ultralow-threshold 2 micrometer microlasers on chip. *Sci China-Phys Mech Astron*, 2015, 58: 114204
- 11 Long H, Huang Y Z, Yang Y D, et al. Mode and modulation characteristics for microsquare lasers with a vertex output waveguide. *Sci China-Phys Mech Astron*, 2015, 58: 114205
- 12 Lin J T, Xu Y X, Fang Z W, et al. Second harmonic generation in a high- Q lithium niobate micro-resonator fabricated by femtosecond laser micromachining. *Sci China-Phys Mech Astron*, 2015, 58: 114209
- 13 Zhou Z H, Shu F J, Shen Z, et al. High- Q whispering gallery modes in a polymer microresonator with broad strain tuning. *Sci China-Phys Mech Astron*, 2015, 58: 114208