

## Electronic Supplementary Information for

### **Buckling Polystyrene Beads with Light**

*Shuangshuang Wang and Tao Ding\**

Key Laboratory of Artificial Micro- and Nano-structures of Ministry of Education of China, School of Physics and Technology, Wuhan University, Wuhan 430072, People's Republic of China.

E-mail: t.ding@whu.edu.cn

#### **Thermal Calculation upon laser irradiation**

As the absorbance coefficient of PS is very small (almost zero) at 445 nm, and no absorber is added, the photothermal effect in the PS beads is legible. The heating, if any, mainly comes from the optical heating of the Si substrate. Therefore, we simplify the model as a laser beam with Gaussian distribution of intensity  $p(r)$  heats the Si cylinder region underneath the PS beads and its thermal conduction.

The distribution of temperature oscillations at surface is<sup>1</sup>

$$\theta(r) = 2\pi \int_0^{\infty} P(k)G(k)J_0(2\pi kr)k dk$$

It can be further simplified as

$$\begin{aligned} \Delta T &= \frac{A}{q\Lambda} \int_0^{\infty} \exp(-\pi^2 k^2 w^2) k dk \\ &= \frac{A}{2\sqrt{\pi}w\Lambda} \end{aligned}$$

As for  $A=1\text{mW}$  laser (445nm), Gaussian waist  $w=0.3 \mu\text{m}$ , thermal conductivity of Si

$\Lambda=142\text{Wm}^{-1}\text{K}^{-1}$ , the maximum temperature increase is  $\Delta T = 6.6\text{K}$

## Figures

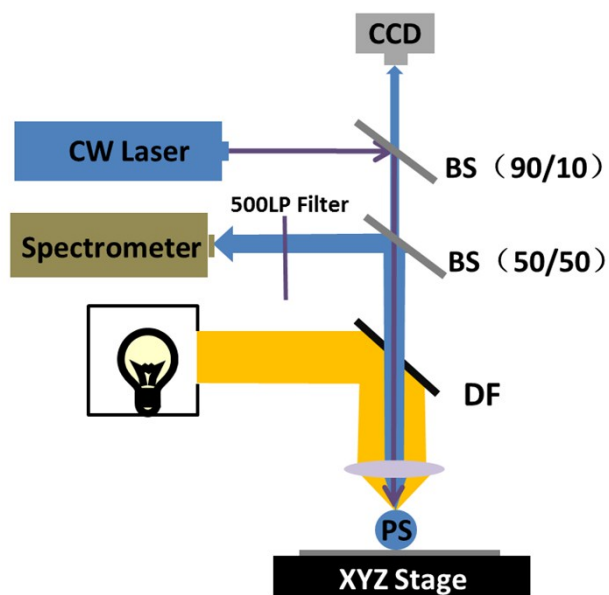


Figure S1. Experimental setup of laser irradiation and the dark field spectra measurement.

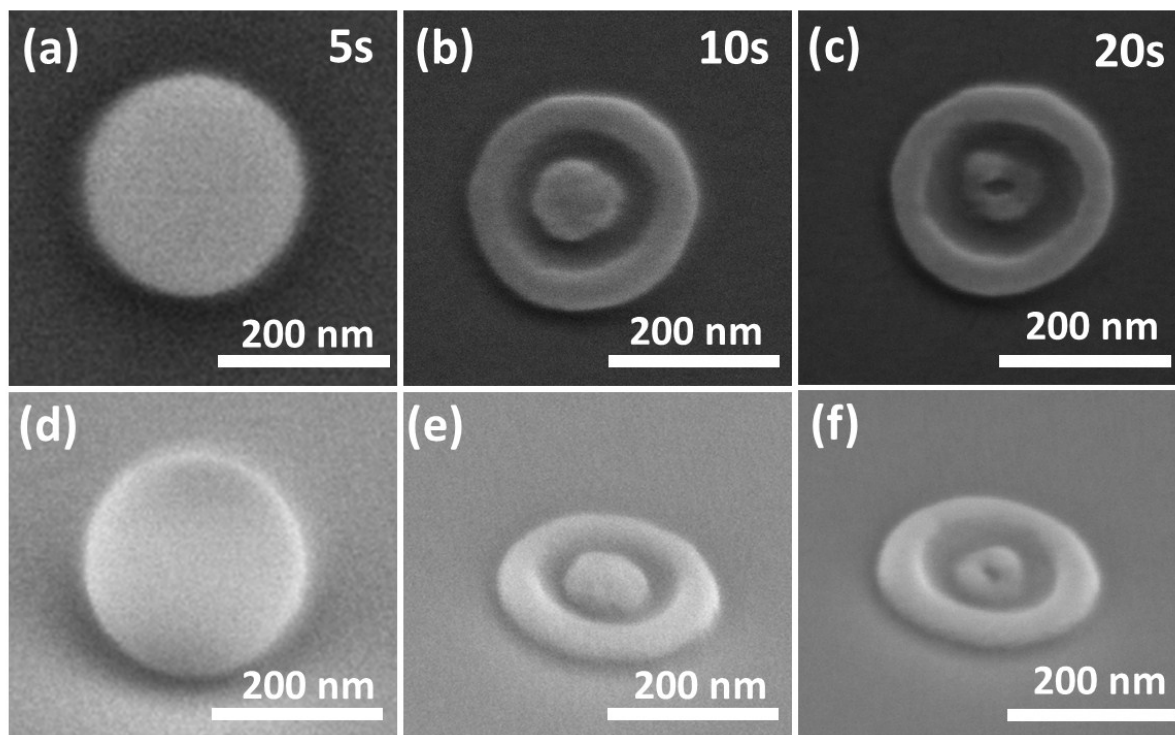


Figure S2. SEM images of PS beads on Si wafer (a,d) before, and after irradiation (1 mW) duration of (b,e) 10s and (c,f) 20s. (a-c) are top views and (d-f) are tilted (45°) views.

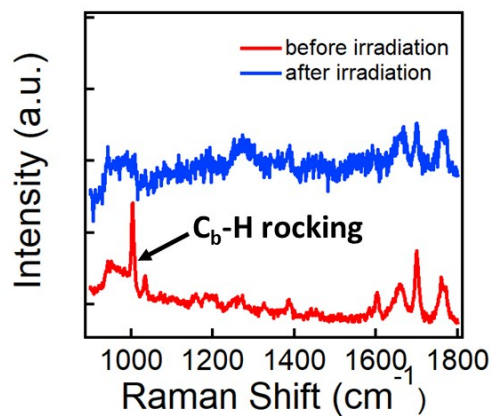


Figure S3. Raman spectra of PS beads before and after laser irradiation (2 mW, 3s). The peak at  $1000\text{ cm}^{-1}$  (C-H rocking on the benzene ring) disappears after the irradiation, suggesting a change of its chemistry probably due to photo-oxidation.

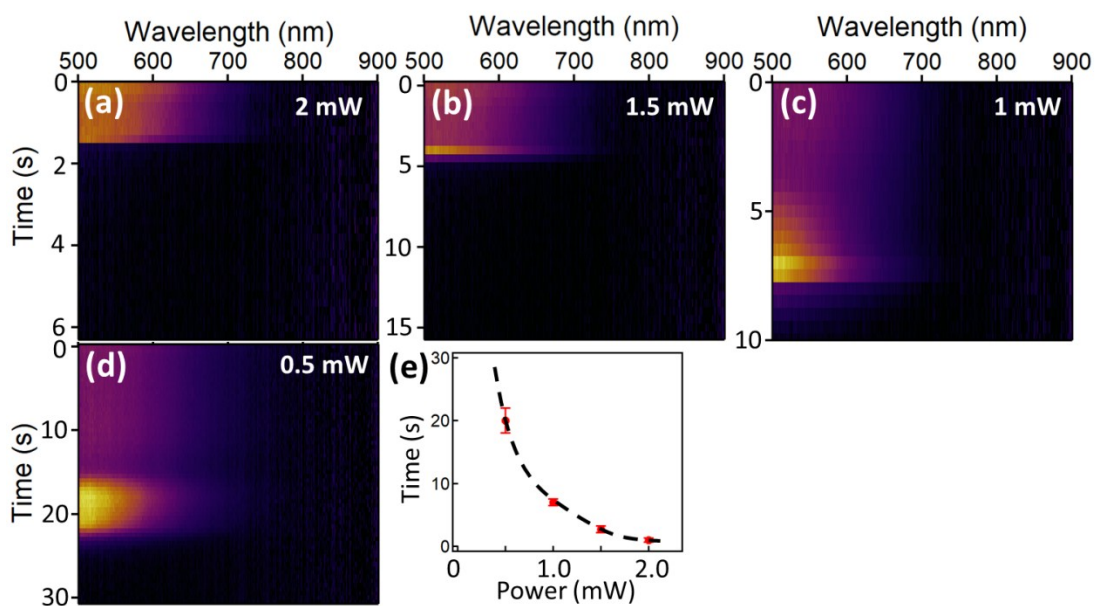


Figure S4 Scattering spectra of irradiated PS beads with different laser powers for different durations. (a) 2mW, (b) 1.5mW, (c) 1mW (d) 0.5mW, (e) Nonlinear power dependence of critical deformation time.

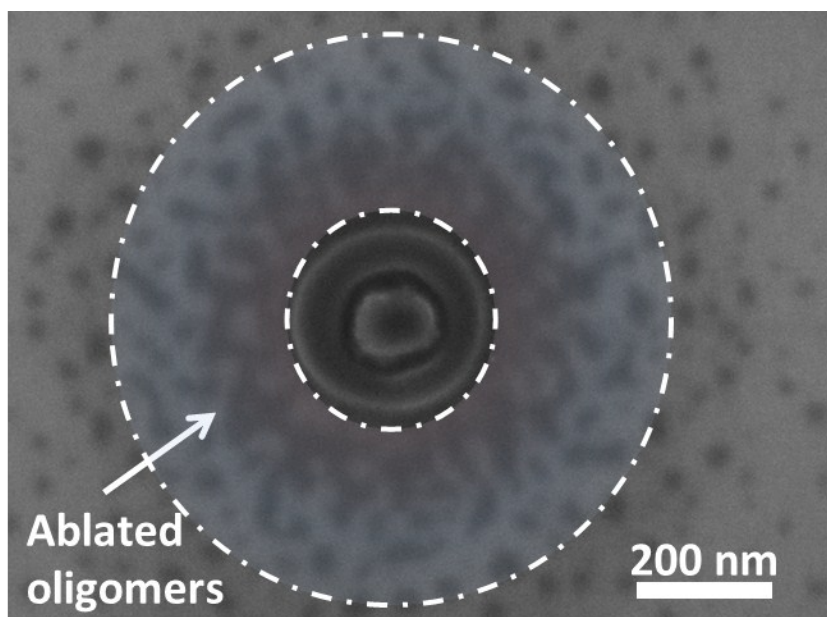


Figure S5. SEM images of irradiated PS beads showing bull's eye shaped patterns with sputtered organic species around (white dashed region).

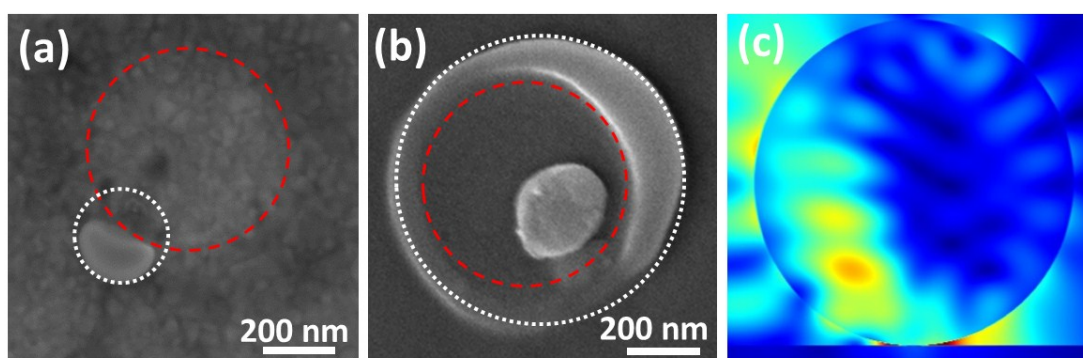


Figure S6. SEM images of irradiated PS beads with misaligned laser beam. (a) 240 nm, (b) 1.0  $\mu\text{m}$ . The white dash line represents the PS beads and the red dash line represents the size of laser beam (c) Near field profile of an irradiated PS bead (1.0  $\mu\text{m}$ ) when laser incidence (Gaussian) is 500 nm off the centre.

#### Reference

- (1). D. G. Cahill, *Rev. Sci. Instrum.*, 2004, 75, 5119-5122.