Supporting Information

Title: **Random Laser Oscillation from Organic Fluorescent Dye Loaded Inside Porous Zirconia Medium**

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Table S1 Preparation conditions of polystyrene microparticles (PS MPs) (Sample codes: PS1 to PS5).

Sample code	NaPPS [mM]	H_2O [mL]	EtOH [mL]
PS1	2.0	139	15
PS2	2.0	124	30
PS3	2.0	109	45
PS4	0.0	149	5.0
PS5	0.0	154	0.0

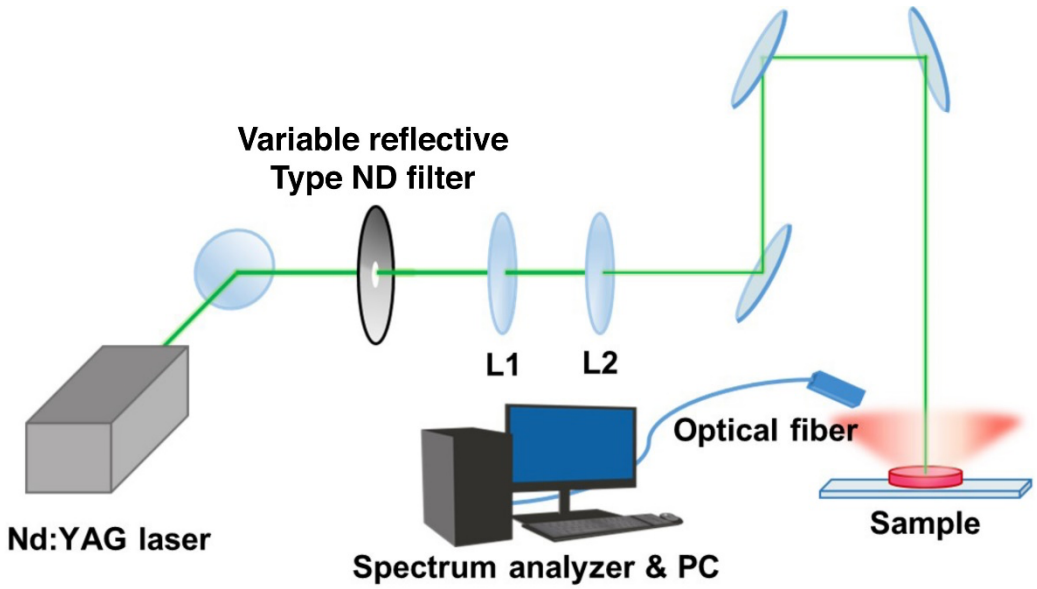

Fig. S1 Scheme of optical system to measure emission spectrum. The detailed specifications should be referred to the Text.

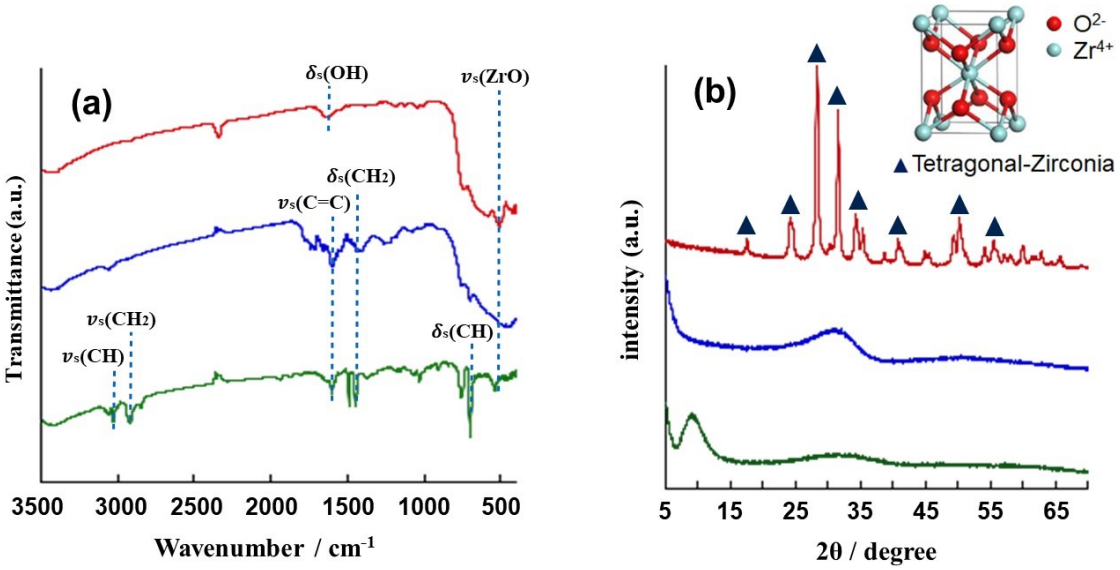

Fig. S2 Changes of (a) FT-IR spectra and (b) powder XRD patterns with the formation process of PZrM calcinated at the elevated temperature. Green line: 75°C, blue line: 350°C, and red line: 580°C.

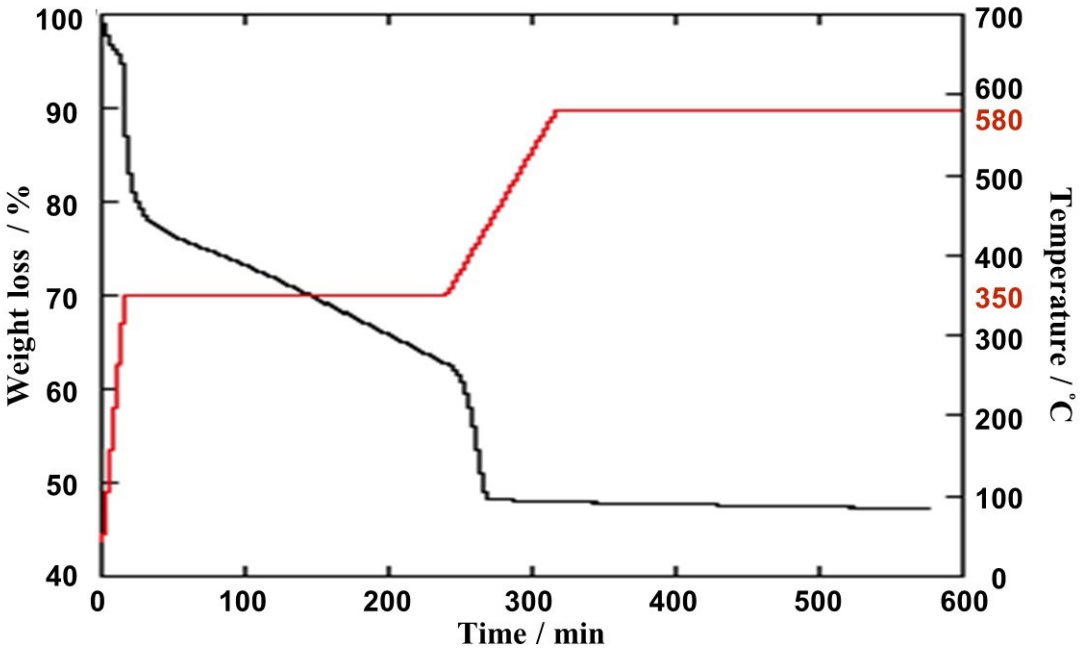

Fig. S3 TGA data at the calcination process with increasing temperature so as to convert into PZrM. Red line: temperature, and black line: weight loss.

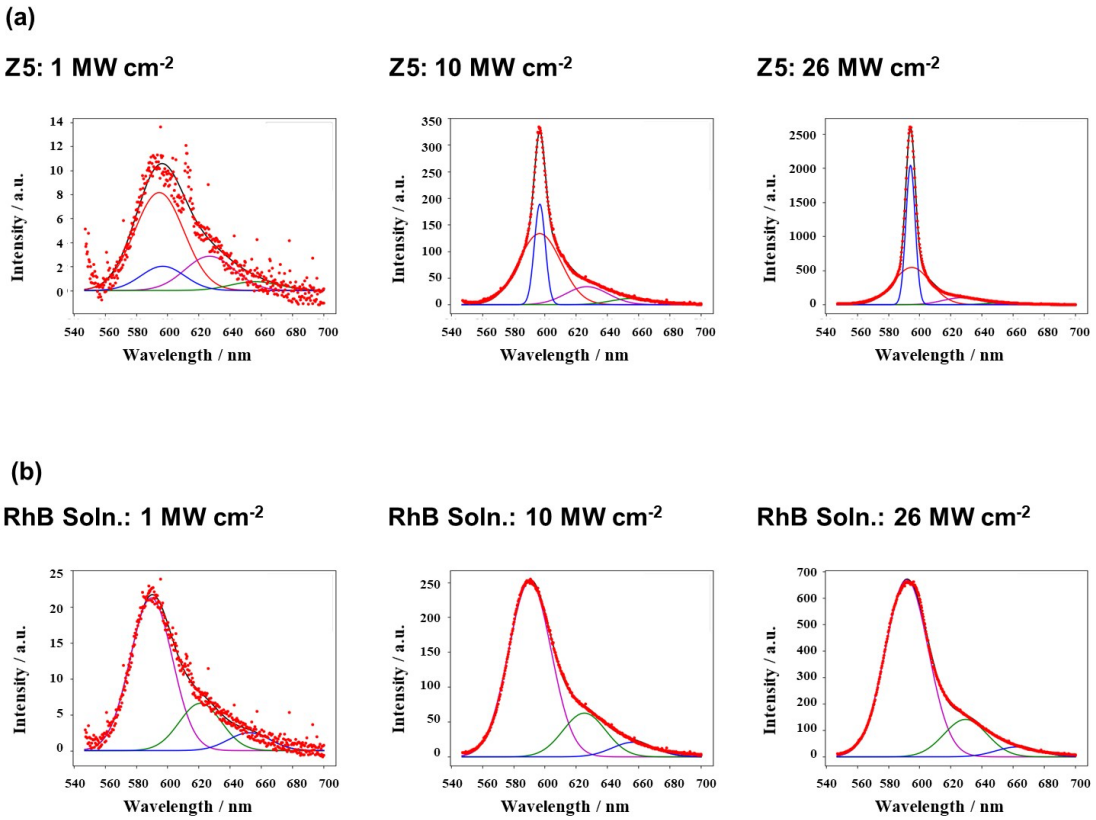

Fig. S4 Examples of the spectrum decomposition in the emission spectra from (a) RhB (1.5 mM, 10 μL) loaded inside PZM5 (1.5 mg), *i.e.*, Z5 (1.5 mg) and also from (b) RhB solution (1.5 mM) in order to separate laser oscillation peak by using Gaussian function. The excitation light intensities were 1, 10, and 26 MW cm^{-2} in any case of Figs. S4(a) and S4(b).

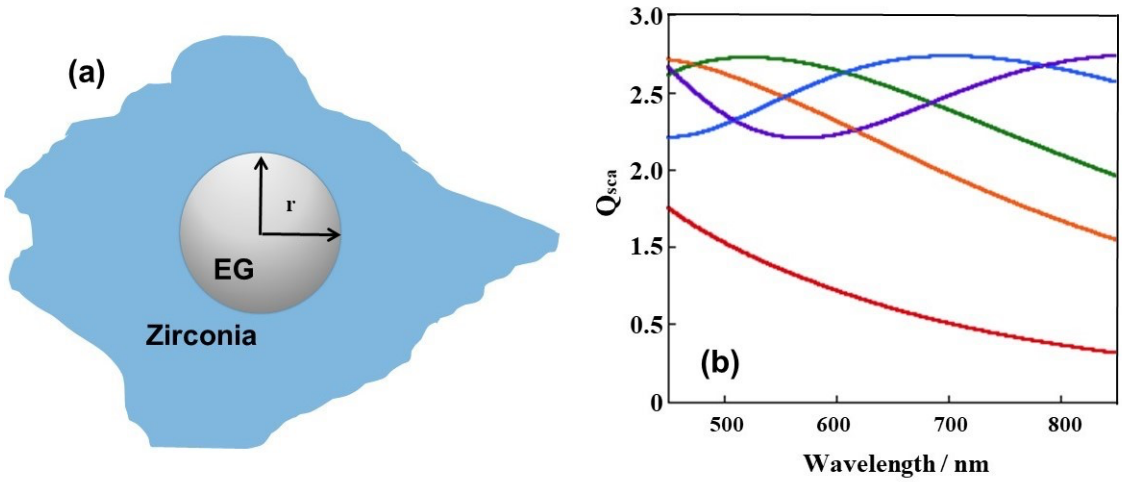

Fig. S5 (a) Schematic picture of optically structural model for PZrM, and (b) the corresponding wavelength dispersion of scattering efficiency (Q_{sca}) simulated at the various radius (r) on the basis of Mie scattering theory. Red line: r = 105 nm, orange line: r = 190 nm, green line: r = 235 nm, blue line: r = 325 nm, and violet line: r = 420 nm.

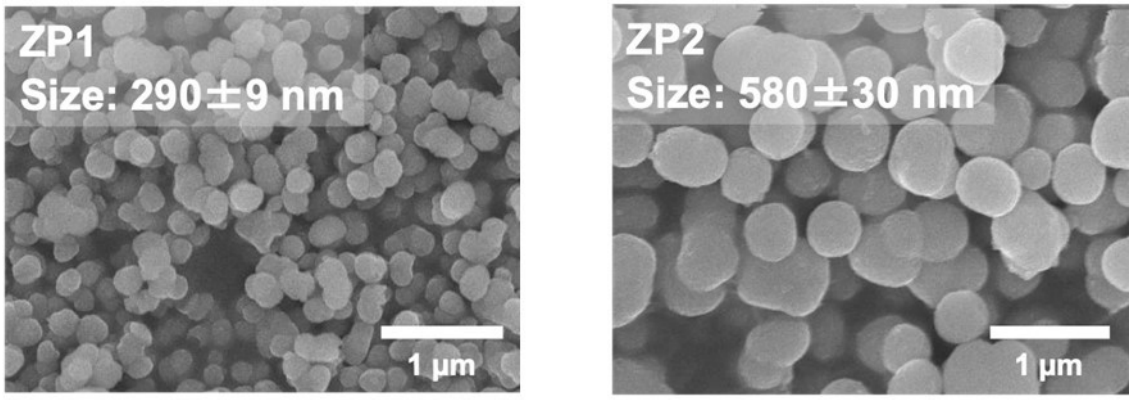

Fig. S6 SEM images of zirconia microparticles (Zr MPs) (Sample codes: ZP1 and ZP2). The particle sizes of ZP1 and ZP2 are 290 ± 9 nm and 580 ± 30 nm, respectively, which were the average values calculated from 100 of specimens taken in SEM images.