

## Supporting information

### Experimental Section

All chemicals were used as received without further purification. Copper (II) chloride ( $\text{CuCl}_2$ ; 99.99%), elemental sulfur powder (98%) from Sigma Aldrich; zinc(II) chloride ( $\text{ZnCl}_2$ ; 99.5%) from Alfa, tin(II) chloride ( $\text{SnCl}_2$ ; 99.5%) from Mallinckrodt; ethanol absolute and hydrochloric acid were from PA Panreac; ethylenediamine were from Osaka Japan. In a typical experimental procedure, the product  $\text{Cu}_2\text{ZnSnS}_4$  can be prepared from a stoichiometric mixture of Copper (II) Chloride ( 0.002 mol), zinc(II) chloride ( 0.001 mol), tin(II) chloride ( 0.001 mol) and elemental sulfur powder ( 0.006 mol) with magnetically stirred in a nitrogen-filled glovebox. The reagents were loaded into a 50 mL Teflon lined autoclave, which was then filled with anhydrous ethylenediamine up to 80% of the total volume. The autoclave was sealed and was maintained at 200 °C for 2 h, and then allowed to cool to room temperature naturally. The black precipitate was filtered and washed with dilute hydrochloric acid, distilled water and absolute ethanol several times to remove the by-products. Finally, the product was dried under vacuum at 60 °C several hours and collected for its characterization.

The CLC mixture used includes a 24.11-wt% nematics (from Merck, MDA3970) and a 75.89-wt% chiral dopant with a left-handness (from Merck, S811). Afterwards, 10 wt% QD with an average diameter of ~3 nm is doped uniformly in the CLC mixture. A planar empty cell is made by piling up two ITO glass substrates, separated by Mylar spacers of 50- $\mu\text{m}$ -thickness. The substrates are coated with polyvinylalcohol films and rubbed along the same direction. The homogeneous mixture is injected into the empty cell at the isotropic temperature of 95 °C and then cool down slowly to room temperature. A planar QDCLC cell with a photonic bandgap within 560–590 nm is then formed.

The lasing output from QDCLC cell is measured after the excitation of the

pumped pulses laser beam based on the experimental setup presented in Figure 1. A second-harmonic-generated pumped-pulses laser beam from a Q-switch Nd:YAG laser (LAB-130, from Quanta-Ray), with a wavelength, a pulse width, and a pulse repetition frequency of 355 nm, 8 ns, and 10 Hz, respectively, is used for the excitation of the sample. The incident beam is focused by a lens (focal length: 20 cm) on the sample at an incident angle of  $90^\circ$  from the normal of the cell. The induced lasing emission along the cell normal is measured behind the cell by using a fiber-based spectrometer with an optical resolution of  $\sim 1.0$  nm (Ocean Optics). A half-wave plate (for 355 nm) and a polarizing polarizer are placed behind the exit of the laser for adjusting the incident pumped energy (E) of the pumped pulses laser beam on the cell. The reflection spectra of the sample is also measured by using a fiber-based spectrometer with an optical resolution of  $\sim 1.0$  nm (USB2000, Ocean Optics).

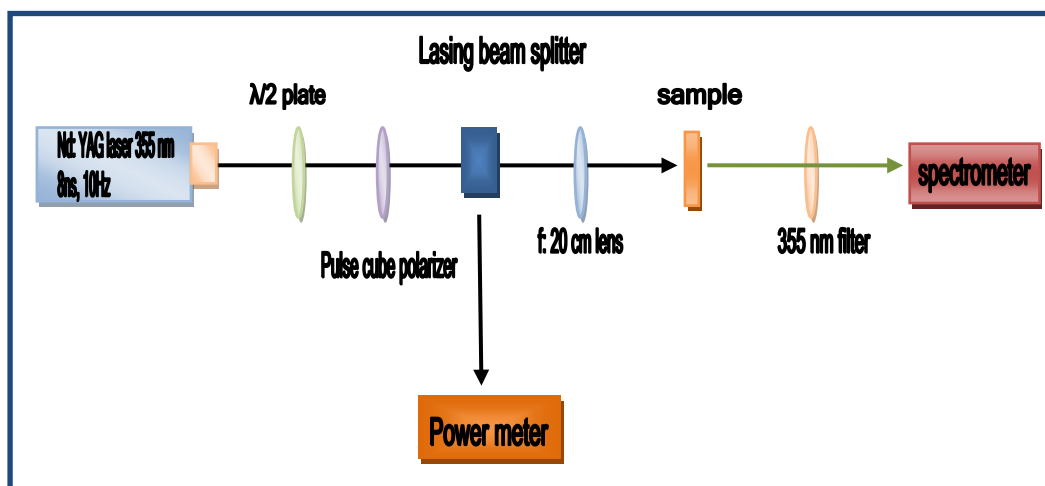


Figure S1. Experimental setup for measuring the lasing output of a QDCLC cell.

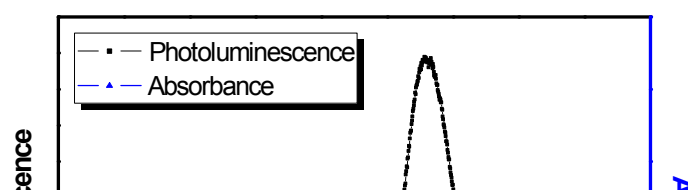
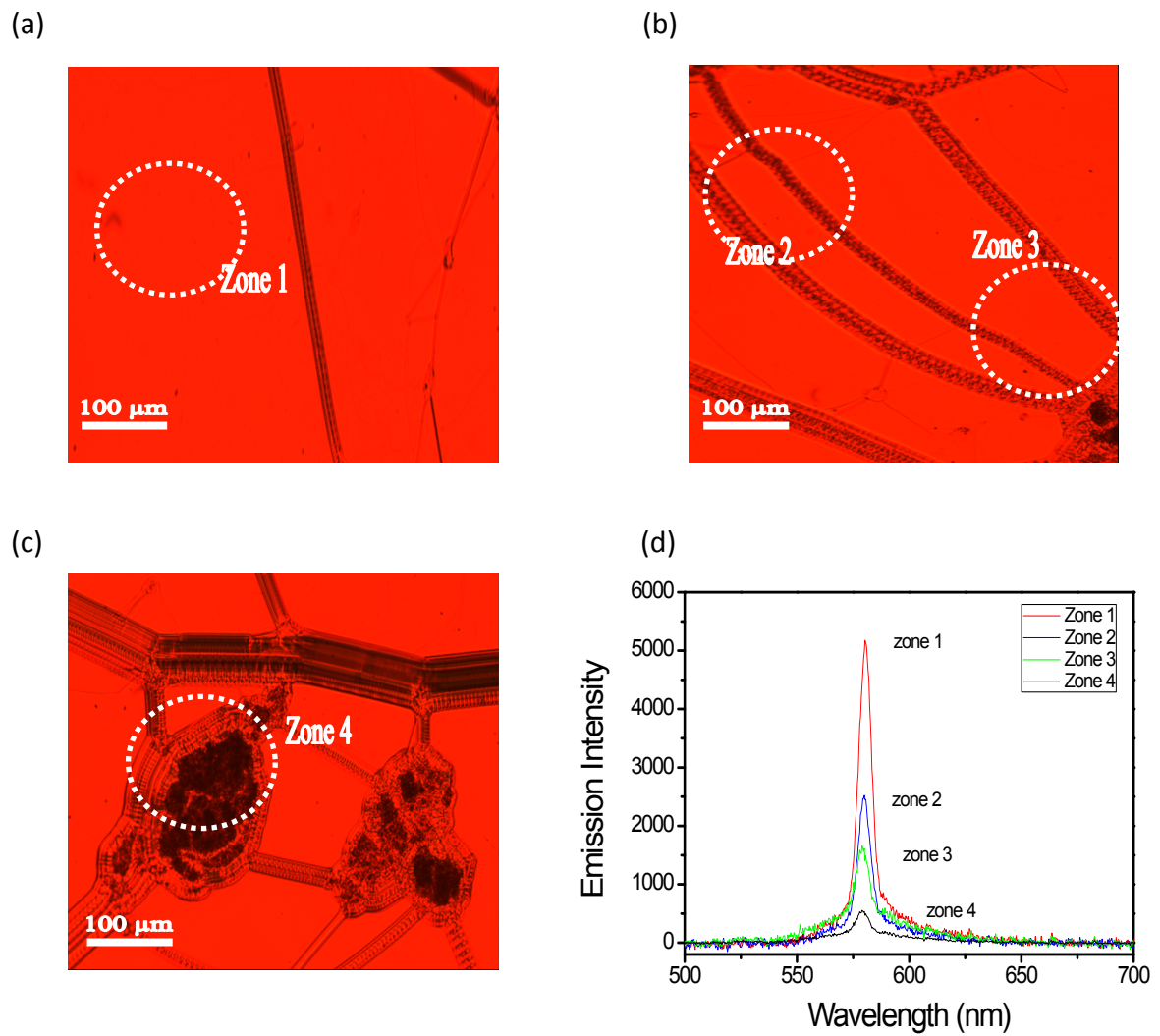


Figure S2. Normalized PL intensity and absorption spectra of CZTS quantum dots.

The absorption and fluorescence emission spectra of the QDs solved in a toluene solution with a molar concentration of  $\sim 0.2$  mmole are pre-measured using a UV-visible spectrometer (U-4100, from HITACHI). The associated results are displayed in Figure S2, in which the peaks of the absorption and fluorescence emission curves are located at 355 and 580 nm, respectively. The two peaks are closed to the pumped wavelength and the bandedge wavelength at the LWE of the CLC stop band for the efficient excitation of the QDs and the efficient fluorescence emission of the QDCLC, respectively.



**Figure S3.** The polarizing microscopy image of QDCLC sample with various quantum dots concentrations. (a) 1 wt% QDCLC sample for zone 1. (b) 2 wt% QDCLC sample for zone 2 and zone 3. (c) 3 wt% QDCLC sample for zone 4. (d) The emission intensity of the QDCLC sample for various locations (zone 1, zone 2, zone 3 and zone 4).

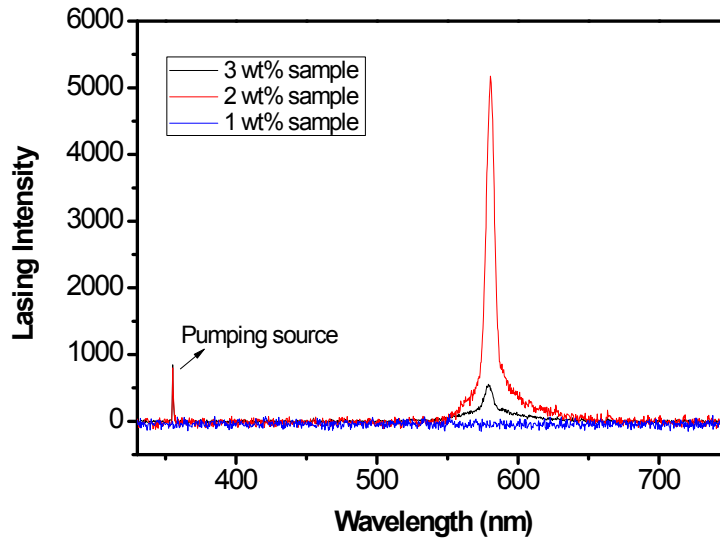


Figure S4. The lasing spectra of the QDCLC with 1wt%, 2 wt%, 3 wt% quantum dots, respectively.

Figure S4 shows the lasing spectra of the QDCLC samples with 1wt%, 2wt%, and 3wt% of quantum dots, respectively. We can see from this figure that lasing intensity increases with quantum dots concentrations increasing. In addition, we could also find that the lasing peak disappear with 3wt% QDCLC sample due to generate more large aggregate quantum dots reduce efficiency. The results suggest that with more aggregated above 2 wt%, the size distribution of the QD becomes more asymmetry and the dot size become larger.

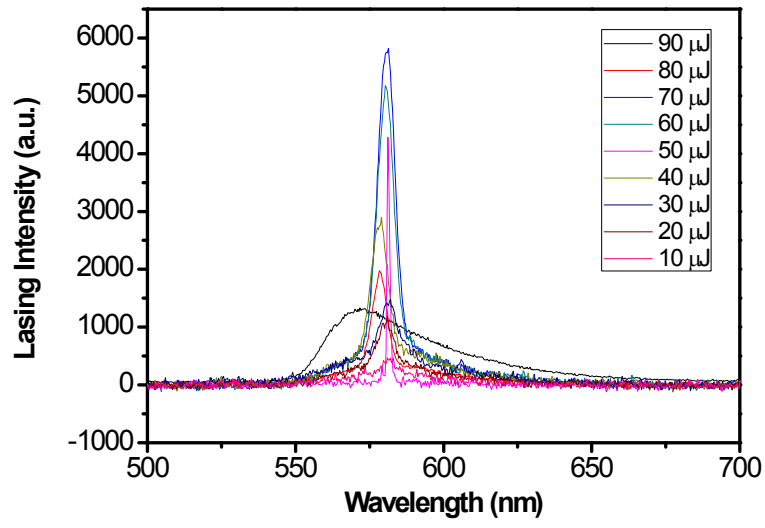


Figure S5. The lasing emission of QDCLC sample with various pumping energy from 10μJ/pulse to 90 μJ/pulse.