

Supplementary information

Cholesteric liquid crystal doped with spiropyran and zinc ions for multi-state anti-counterfeiting

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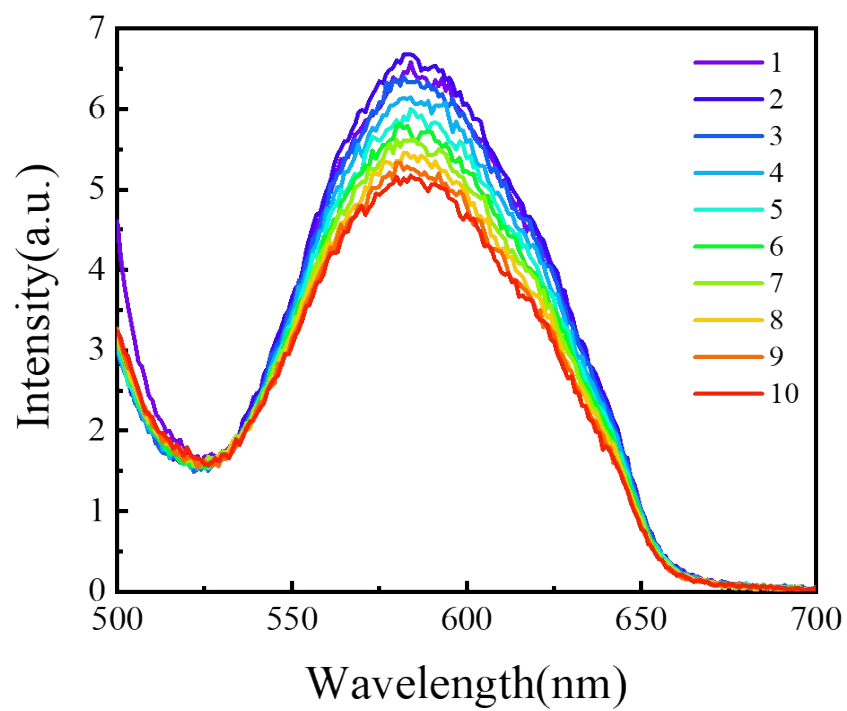


Figure S1. Fluorescence emission spectrum after UV irradiation for 10 cycles of Spiropyran.

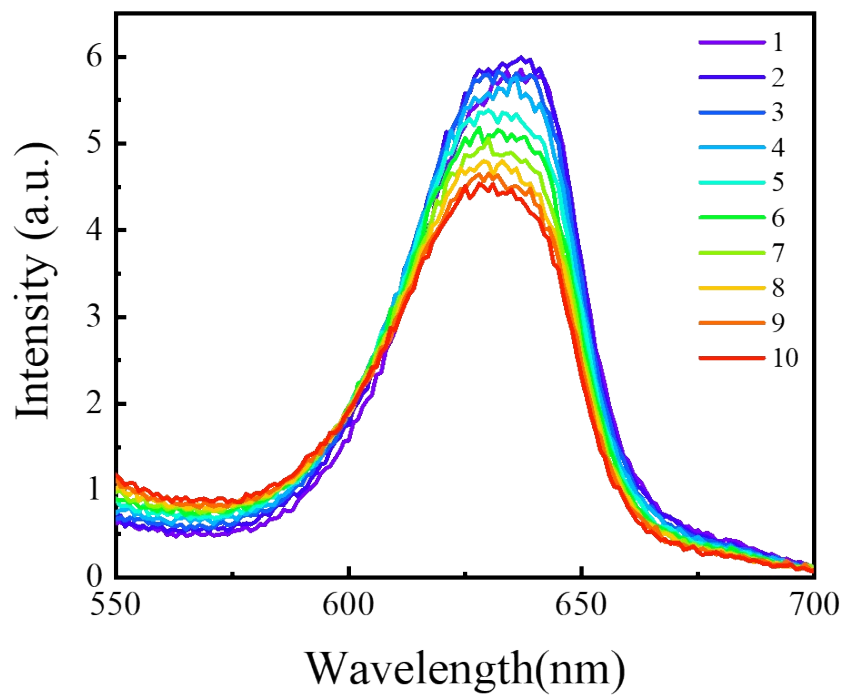


Figure S2. Fluorescence emission spectrum after UV irradiation for 10 cycles of Spiropyran/Zn²⁺ mixture.

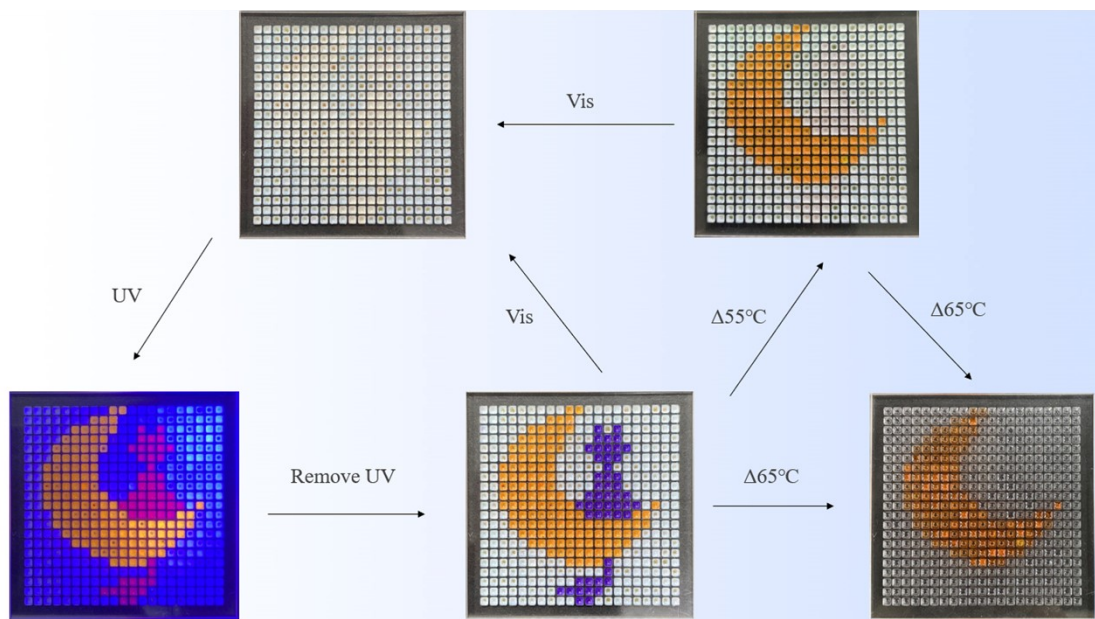


Figure S3. Polymeric ink labels with different information. A schematic illustration of a multi-state label designed with three different inks, depicting "a cat sitting on the moon" (10cm×10cm), as well as five label photos obtained through light or temperature control. These five photos carry different information.

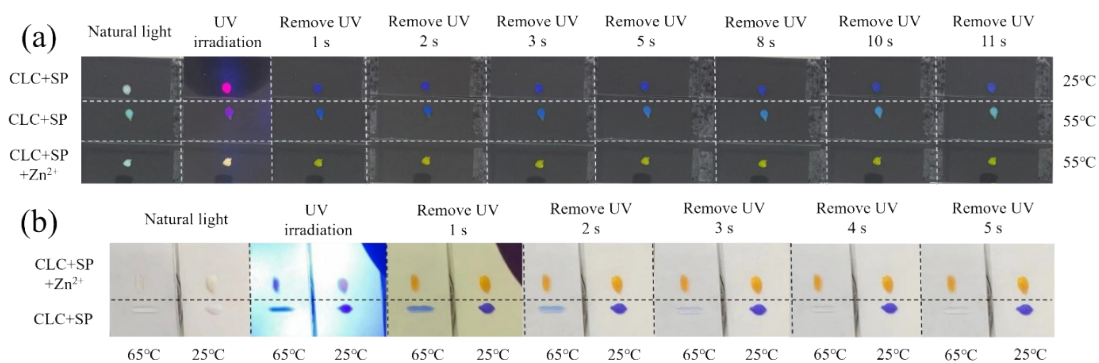


Figure S4. (a) Stability of photochromism of liquid crystal doped with spiropyran dye at different temperatures. (b) Stability of photochromism of the dye after removing the inherent structural color of the liquid crystal.

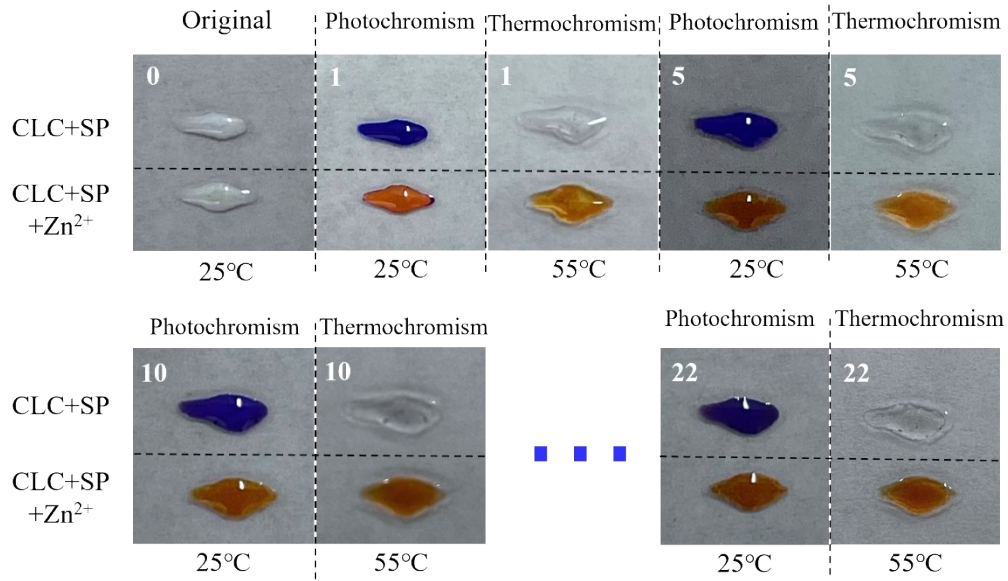


Figure S5. Repeatability of photochromism and thermochromism of spiropyran dye and Zn²⁺ doped in CLC.

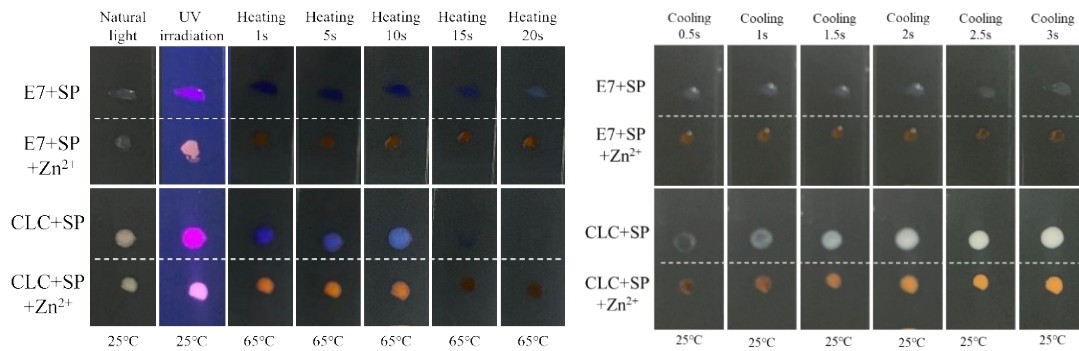


Figure S6. The response time and thermal stability after heat removal of SP and Zn²⁺ doped CLC and E7 were investigated.

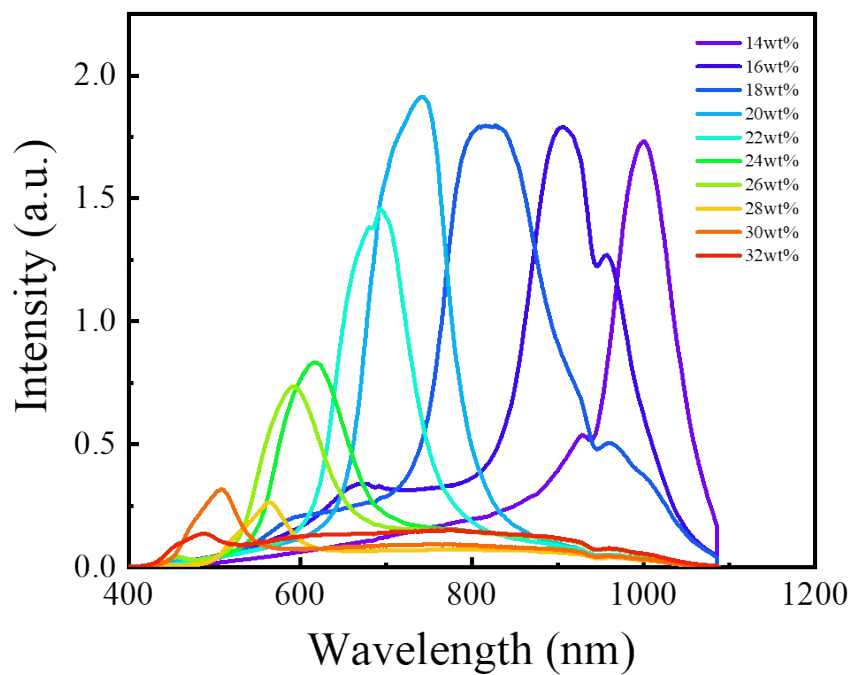


Figure S7 The corresponding reflection spectrum of cholesteric liquid crystal (CLC) as the proportion of chiral agent S2011 increases from 14 wt% to 32 wt% in increments of 2 wt%.

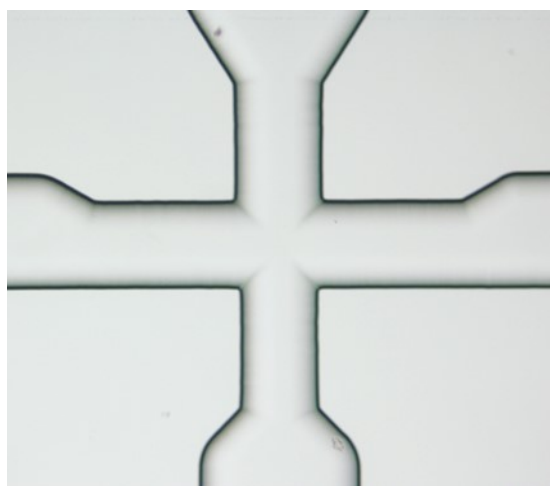


Figure S8 Photograph of the glass microfluidic chip with a cross-channel used in this experiment.

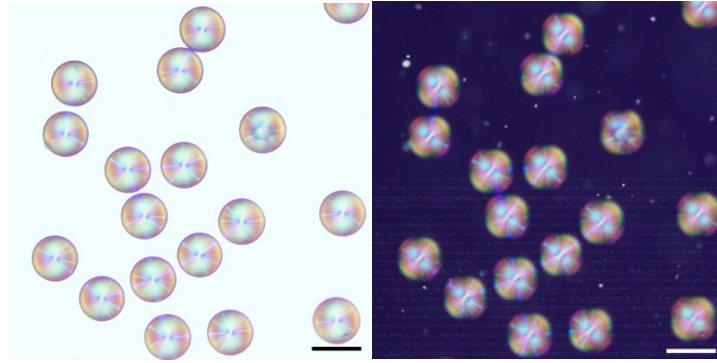


Figure S9 The Reflection Optical Microscope (ROM) image and Polarization Optical Microscope (POM) image of CLC microspheres prepared using microfluidic technology. (The bar is $80\mu\text{m}$.)

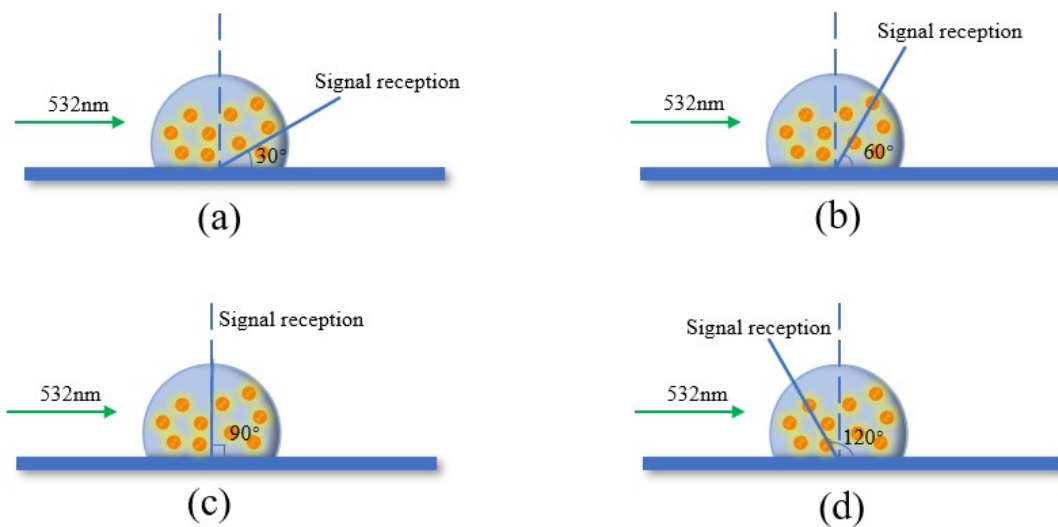


Figure S10 Validate the schematic diagram of CLC omnidirectional laser. Rotate the signal receiver counterclockwise by 30° , 60° , 90° , and 120° respectively.

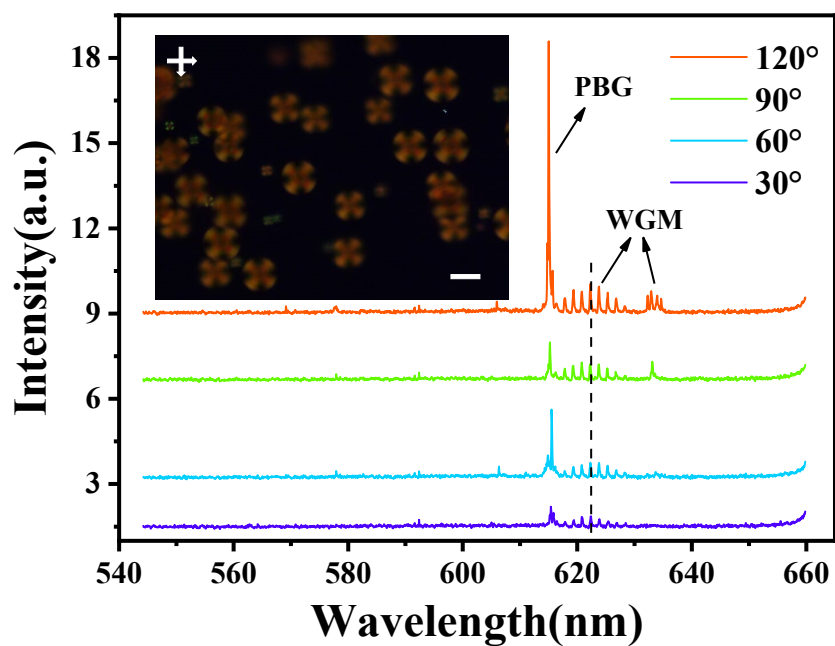


Figure S11 The laser spectra measured when the signal receiver is rotated by 30°, 60°, 90°, and 120°. The inset presents the microscopic image of liquid crystal microspheres doped with DCM dye under a cross-polarized optical microscope. Scale bar: 50 μm

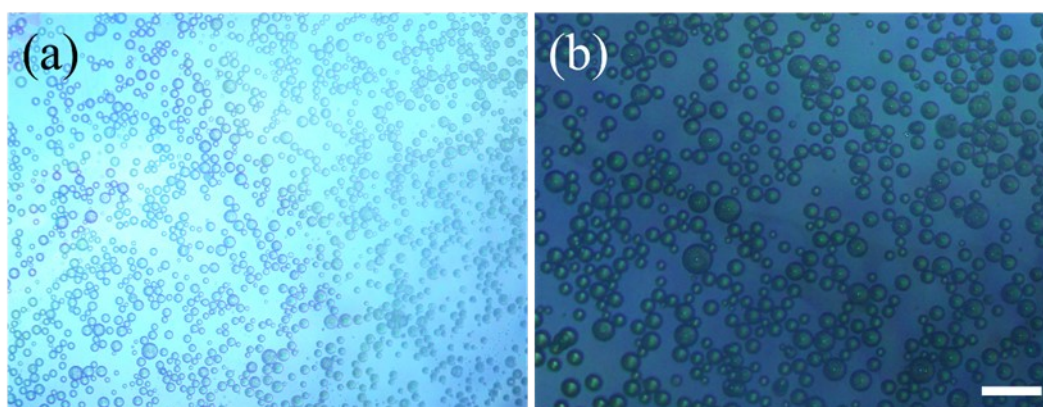


Figure S12 Preparation of CLC microdroplets with different diameters using magnetic stirring at (a) 800 rpm and (b) 400 rpm. Scale bar: 100 μm .

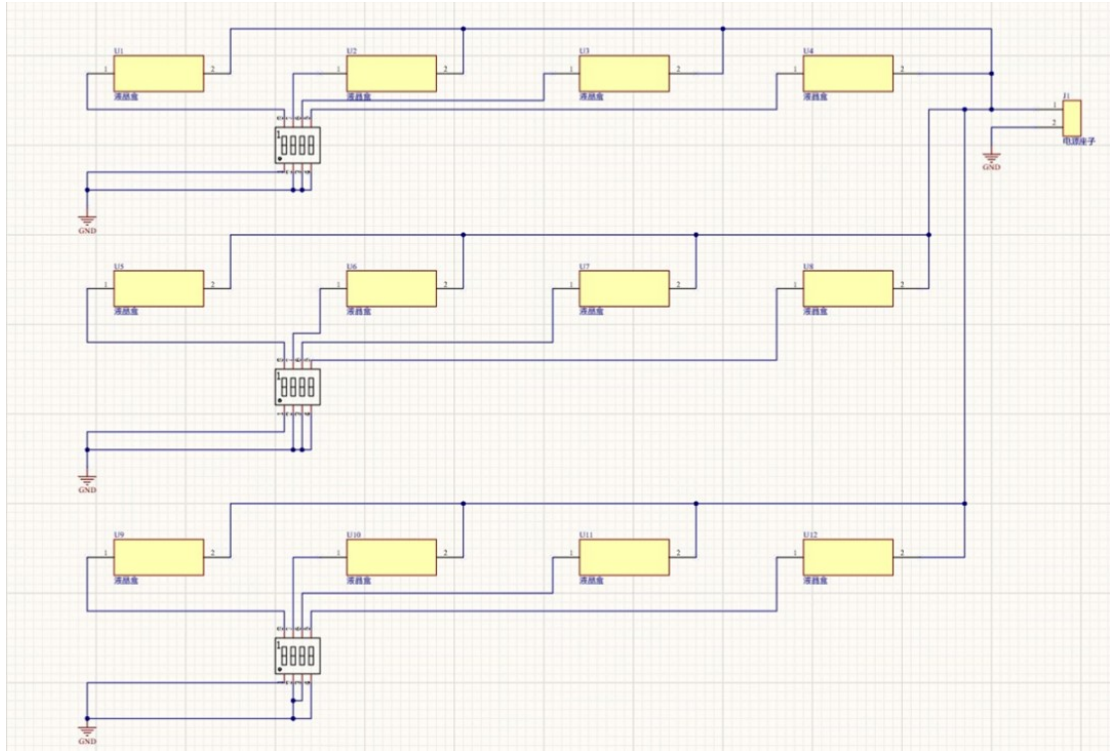


Figure S13 Schematic diagram of the circuit corresponding to the powered anti-counterfeiting section.

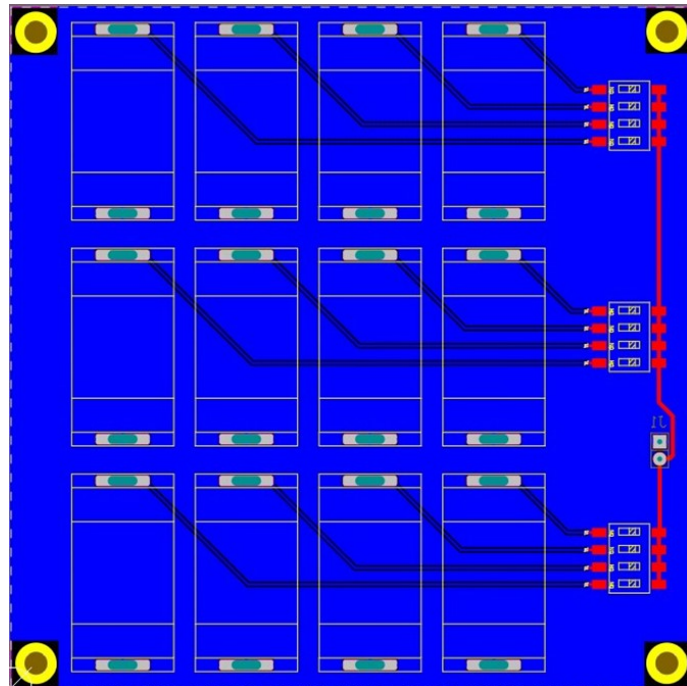


Figure S14 The PCB design diagram corresponding to the powered anti-counterfeiting part.