Supporting Information

A High-Sensitivity PtNPs@$CsCu_2I_3$ Single-Crystal UV Photodetector for Precision Sunscreen Protection Monitoring

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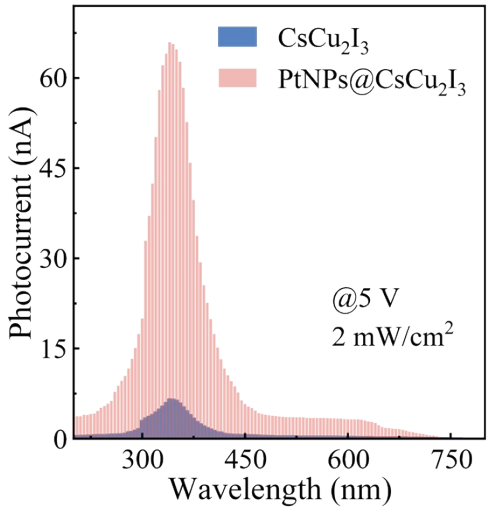

Figure S1. Wavelength-dependent photocurrent of the fabricated photodetectors when measured at 5 V bias (the light irradiance was maintained at 2 mW/cm^2), where the $CsCu_2I_3$ SC was uncoated and coated with PtNPs. The measured peak photocurrent of the PtNPs@$CsCu_2I_3$ SC detector at 340 nm is 66 nA, which is 10-fold than that of the pristine one.

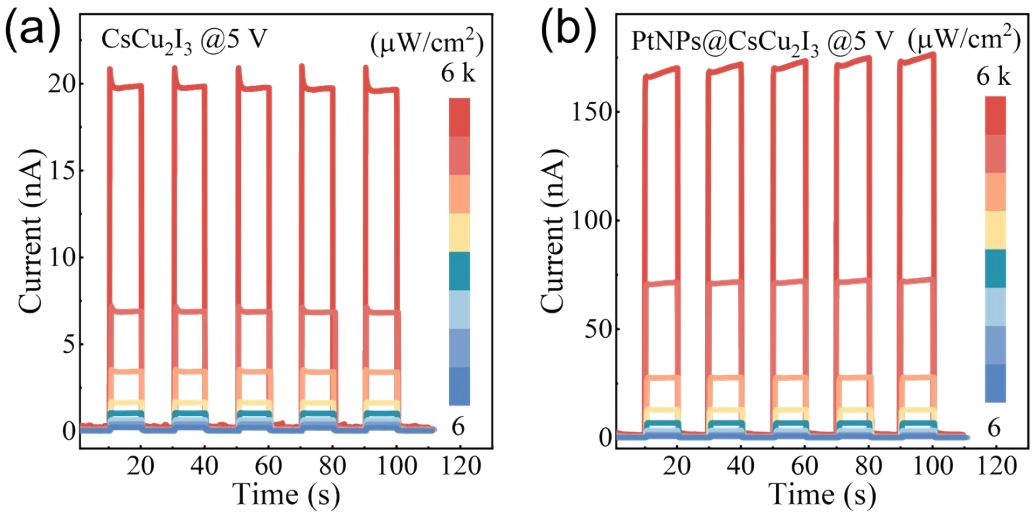

Figure S2. Time-dependent photocurrent of the fabricated photodetectors when measured at 5 V bias (The light irradiance was maintained at the range of 6 μW/cm^2 to 6 mW/cm^2), in which the $CsCu_2I_3$ SC was (a) uncoated, and (b) coated with PtNPs.

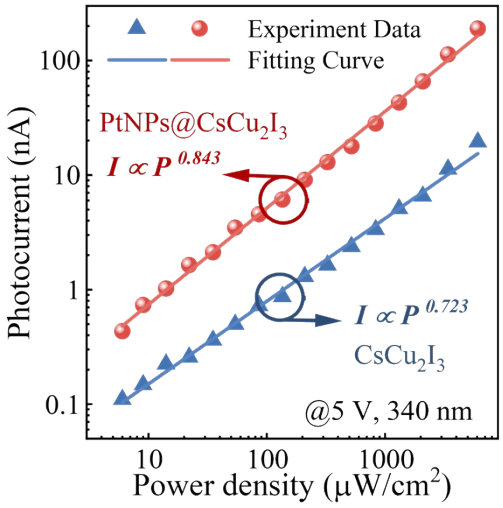

Figure S3. Light irradiance-dependent photocurrent of the fabricated photodetectors when measured at 5 V bias (the light wavelength was 340 nm), where the $CsCu_2I_3$ SC was uncoated and coated with PtNPs. The exponent θ can be fitted to approximately 0.723 for the pristine $CsCu_2I_3$ SC detector. After coating with PtNPs, the fitted θ value increases to around 0.843.

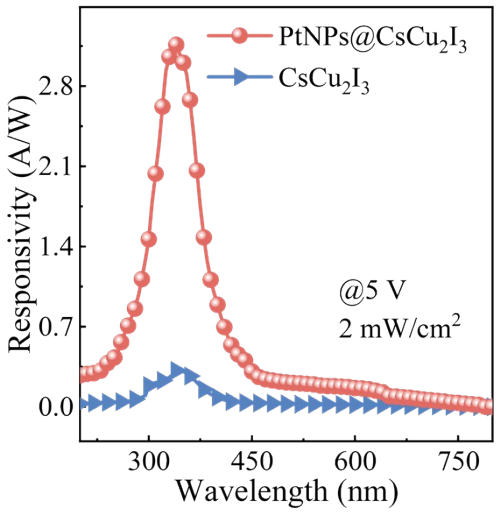

Figure S4. Wavelength-dependent responsivities of the fabricated photodetectors when measured at 5 V bias (The light irradiance was maintained at 2 mW/cm^2), where the $CsCu_2I_3$ SC was uncoated and coated with PtNPs. The measured peak responsivity of the PtNPs@$CsCu_2I_3$ SC detector at 340 nm is 3.2 A/W, which is 10-fold than that of the pristine one.

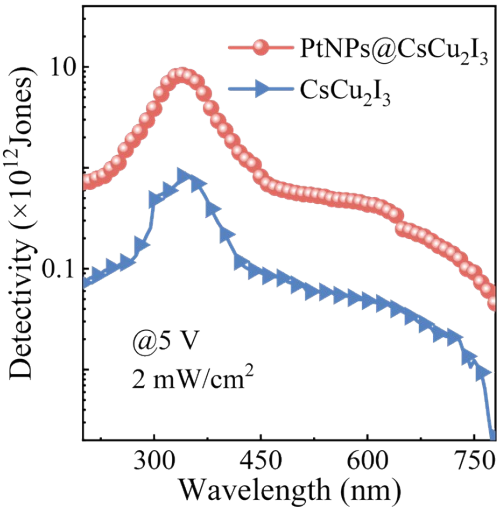

Figure S5. Wavelength-dependent detectivities of the fabricated photodetectors when measured at 5 V bias (The light irradiance was maintained at 2 mW/cm^2), in which the $CsCu_2I_3$ SC was uncoated and coated with PtNPs. The measured peak detectivity of the PtNPs@$CsCu_2I_3$ SC detector at 340 nm is 8.33 × 10^{12} Jones, which is 10-fold than that of the pristine one.

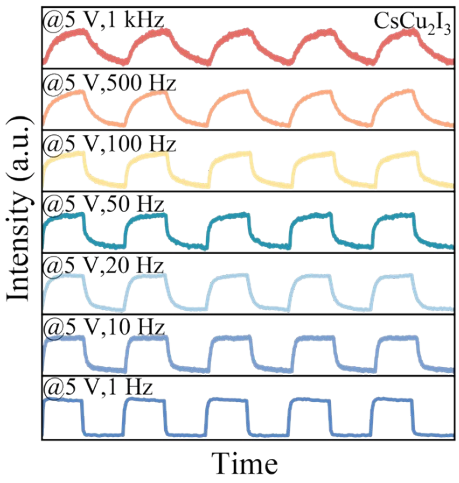

Figure S6. The pristine $CsCu_2I_3$ SC detector's photoresponse characteristics to pulsed light (340 nm) at varying modulation frequencies in the range of 1 to 1k Hz.

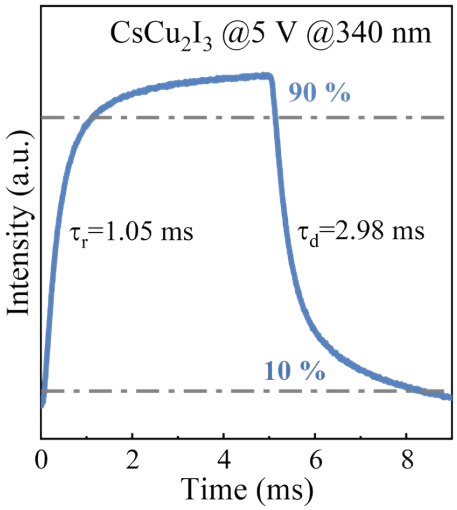

Figure S7. Transient response of the pristine $CsCu_2I_3$ SC detector to 340 nm light pulses at 5 V bias, showing a rise time of 1.05 ms and a decay time of 2.98 ms.

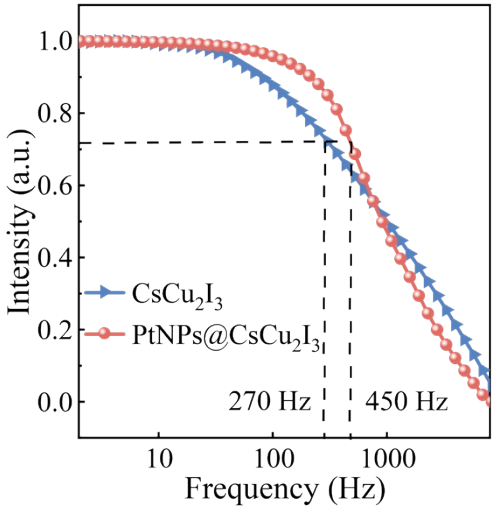

Figure S8. Normalized photoresponse as a function of modulation frequency for the pristine and PtNPs@$CsCu_2I_3$ photodetectors under 340 nm illumination at 5 V. The -3 dB cutoff frequency is 270 Hz for the pristine device and 450 Hz for the PtNPs-coated device, defining the operational bandwidth of each detector.

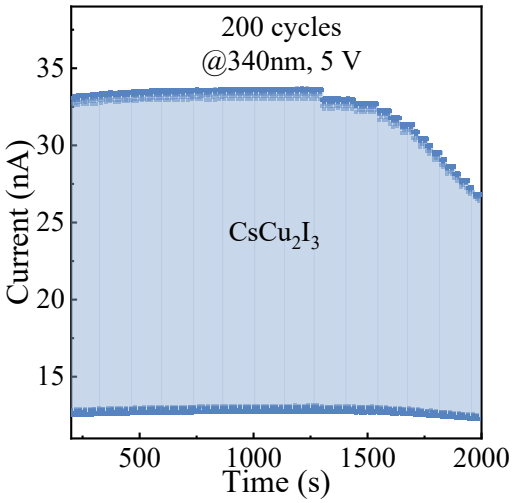

Figure S9. Long-term photoresponse curve of the pristine $CsCu_2I_3$ under 340 nm LED irradiation via 6 mW/cm² at 5 V bias.

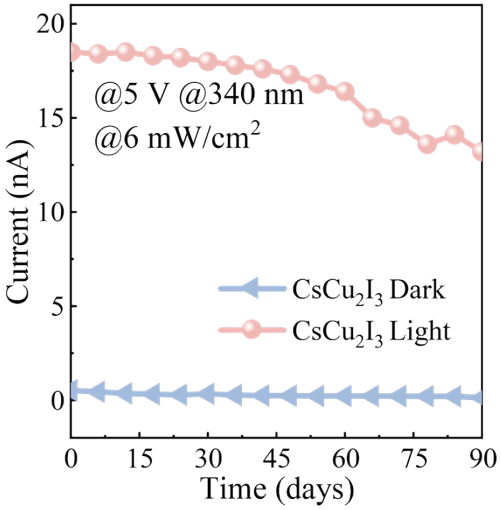

Figure S10. The variation of recorded photocurrent as a function of storage duration.

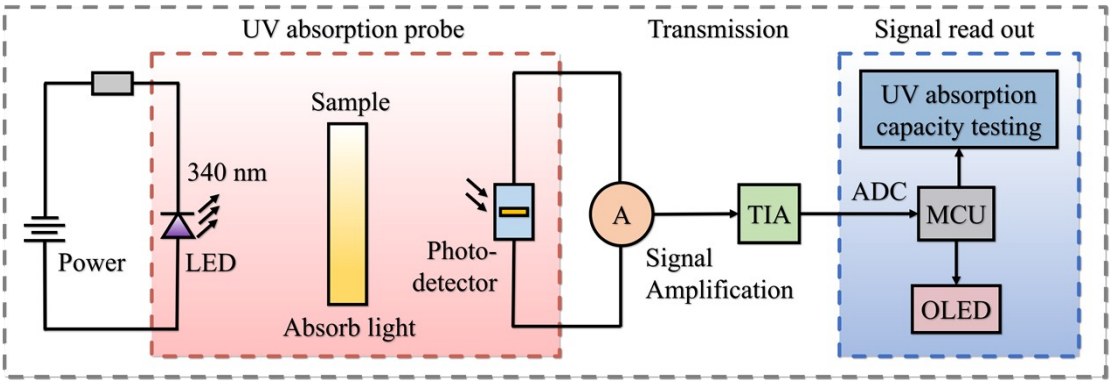

Figure S11. Schematic diagram of the custom UV monitoring system for evaluating sunscreen protection performance. The system comprises a 340 nm UV-LED light source, a sample stage for sunscreen film application, the PtNPs@$CsCu_2I_3$ SC detector as the signal receiver, and a signal processing unit for data acquisition and real-time display on an OLED screen. In which, the signal processing unit is made of a transimpedance amplifier (TIA), analog-to-digital converter (ADC), and microcontroller (MCU).