Supporting Information

Temperature-Responsive Fluorescent Polygalacturonic Acid: A Step Towards Wound Monitoring with Smartphone Imaging

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Thermal Response of Pristine PPE-CO_2-108

PPE-CO_2-108 samples prepared in 0, 150, and 300 mM of NaCl were heated (red shade) and kept at the desired temperature for 8 minutes, then cooled back to 20°C (white shade) and monitored for 30 minutes. In the presence and absence of NaCl, we observed a reversible thermal response described by fluorescent enhancement (at 450 nm) in the heating phase followed by a rapid decrease, especially at higher ionic strength, in the intensity when the solution is cooled back to 20°C. However, the fluorescent enhancement was more significant at higher ionic strength as the maximum intensity increased from 1.3x at 0 mM NaCl to 2.0x and 3.4x at 150 and 300 mM NaCl, respectively.

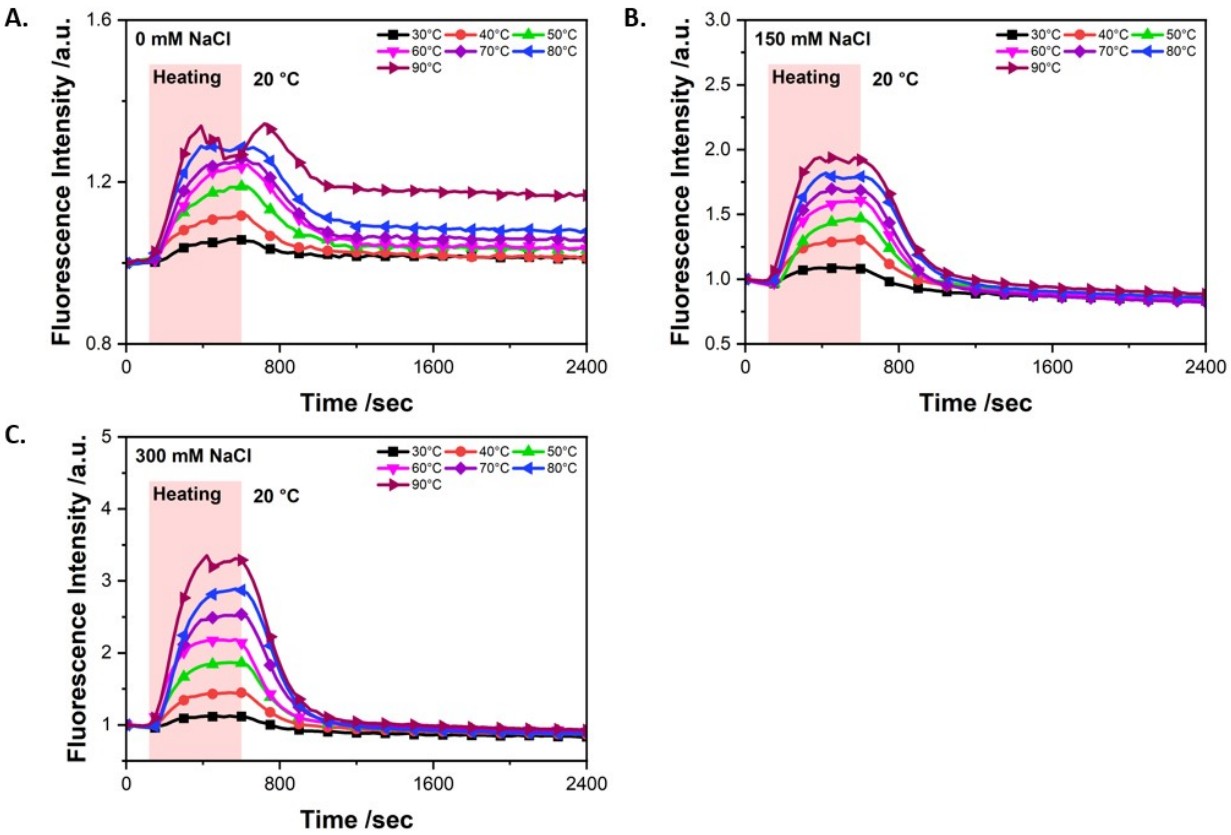

Figure S1: Fluorescent temperature response of PPE-CO_2-108 in HEPES buffer (10 mM, pH= 7.0) while and after heating **(A)** without NaCl, **(B)** with 150 mM NaCl, and **(C)** with 300 mM NaCl. All the time trajectories were measured at 450 nm after excitation at 405 nm. The samples were kept at 20°C for 2 minutes. At t= 2 minutes, the temperature was increased, and the samples were kept at the desired temperature for 8 minutes before cooling back to 20°C. Symbols are just for visual aid.

Thermal Sensing of PGA/ PPE-CO_2-108 at different PGA and NaCl Concentrations

Different PGA/PPE-CO_2-108 solutions were prepared at different PGA concentrations and ionic strengths. The solutions were heated from 20 to 90°C with 5°C increments and emission spectra were acquired at each temperature. The absolute sensitivities were then calculated and summarized in **Table S1.**

Table S1: Absolute sensitivity of PGA/PPE-CO_2-108 at different PGA concentrations and ionic strengths.

PGA concentration		**0.30 mg/mL**	**0.35 mg/mL**	**0.50 mg/mL**	**0.70 mg/mL**	**1.7 mg/mL**
150 mM NaCl	Absolute sensitivity 20-40°C	0.0052	0.0078	0.0080	0.0078	0.01123
	Absolute sensitivity 45-90°C	0.0124	0.0155	0.0133	0.0133	0.0240
300 mM NaCl	Absolute sensitivity 20-40°C	0.0060	0.0069	0.0064	0.0062	0.0092
	Absolute sensitivity 45-90°C	0.0156	0.0133	0.0162	0.0141	0.0162

Titration of PPE-CO_2 solution with PGA in the Absence of NaCl:

Emission spectra of PPE-CO_2 -108 upon incremental addition of PGA in HEPES buffer (10 mM, pH = 7.0, 0 mM NaCl) was recorded. The emission spectrum of pristine PPE-CO_2-108 exhibited a broad, structureless peak centered at 520 nm as the result of the aggregated CPEs which are believed to emit from an excimer-like state. With the addition of PGA, we observed a subtantial increase in the fluorescence intensity at 450 nm reflecting the disaggregation of the CPE polymer chains.

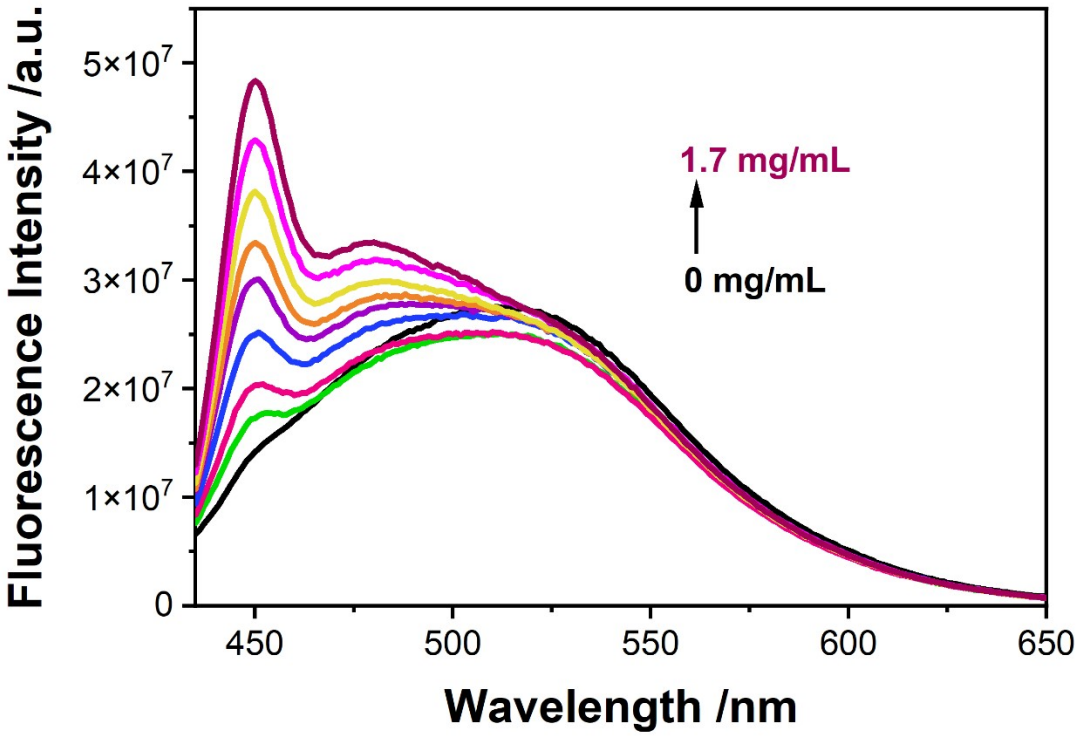

Figure S2: Emission spectra of PPE-CO_2-108 upon incremental addition of PGA in the absence of NaCl. The samples were excited at 405 nm and prepared in 10 mM HEPES at pH = 7.0.

Lifetime Measurements

Lifetime measurements of PGA/PPE-CO_2-108 complex were taken at 0 mM and 300 mM NaCl concentrations, at 20°C and when heated to 90°C.

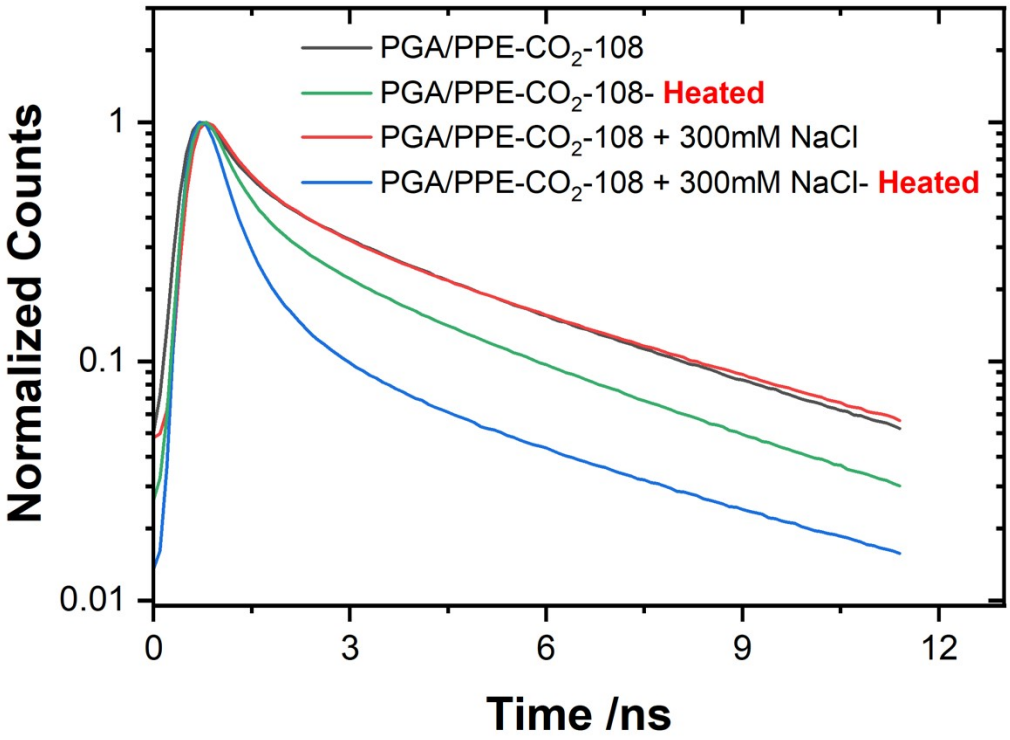

Figure S3: fluorescence decay curves of PGA/PPE-CO_2-108 at 0 and 300 mM NaCl, both at 20°C and when heated to 90°C. These were used in extracting the lifetime data found in Table 1.

Fluorescence response upon Abrupt changes in temperatures:

When the temperature is changed abruptly, we noticed a decrease in the fluorescence intensity at 450 nm and restructuring at the 520 nm peak. We believe this is due to the slow interaction between

the PGA and PPE-CO2-108 macromolecules with the sudden changes in temperatures.

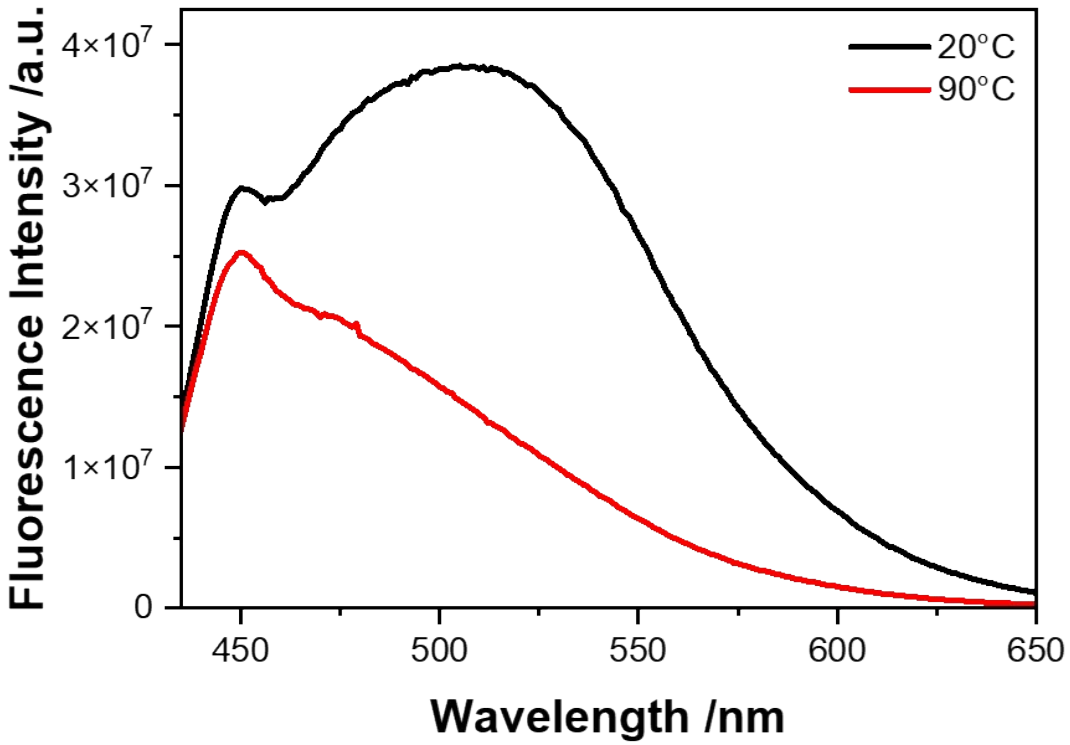

Figure S4: Fluorescent changes of PPE-CO_2-108 with 0.35 mg/mL PGA upon an increase in temperature of the solution from 20°C to 90°C in 0 mM NaCl upon excitation at 405 nm.

Scanning Electron Microscopy:

Scanning electron microscopy images of the prepated films revealed a uniform texture at the macroscale, with minor roughness at the microscale level with a measured thickness of 3.4 mm (**Figure S5**).

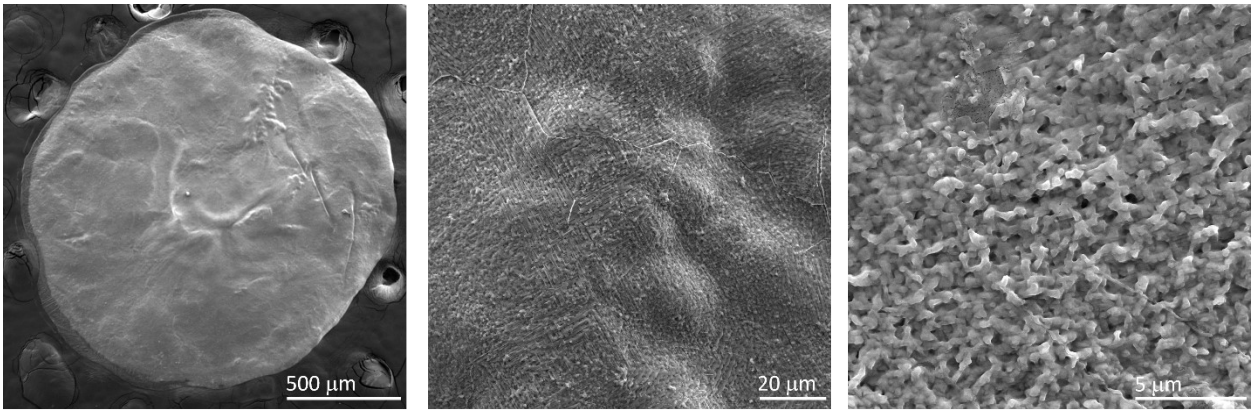

Figure S5: Scanning electron microscopy images of the prepared PGA/PPE-CO_2-108 films under different magnifications.

Thermal Sensing in Thin Films:

After heating the polymeric films prepared in 0 mM NaCl and imaging them, the green, blue, and red channels were extracted and analyzed using ImageJ. The change in the intensity of the green channel with the change in temperature is represented by **Figure S3.** The plot of intensity versus temperature shows a linear range between 25 and 55°C with absolute sensitivity of 0.008 $°C^{-1}$ and relative sensitivity of 0.8%$°C^{-1}$ at 25°C.

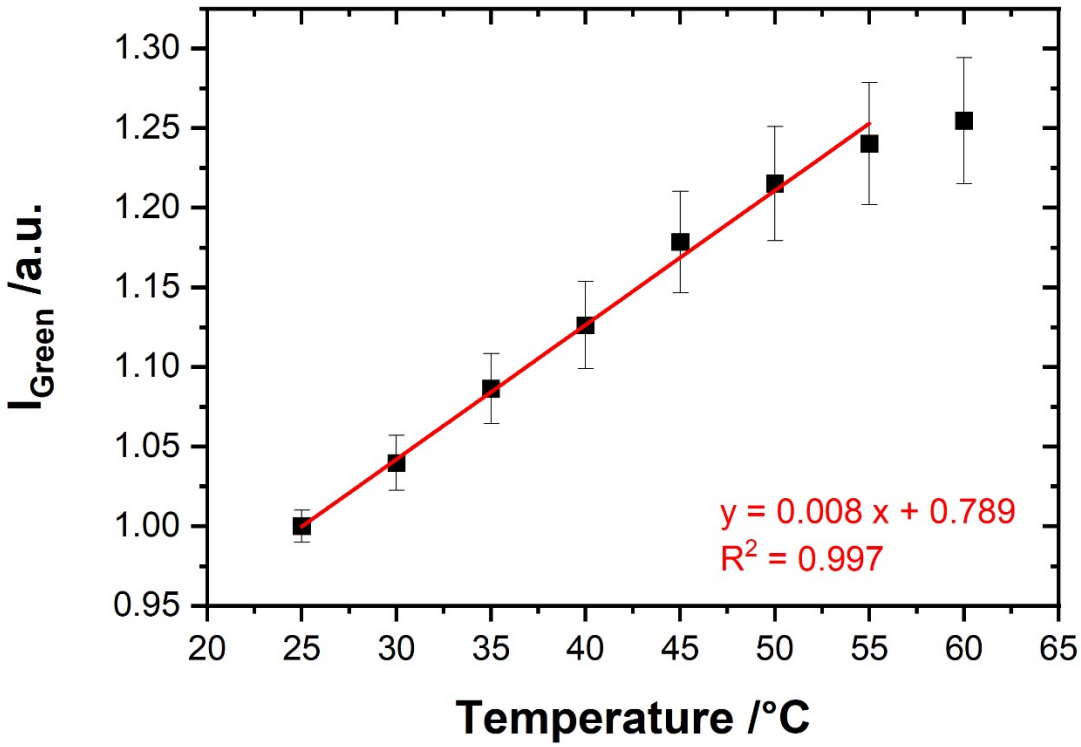

Figure S6: Fluorescent intensity obtained by disserting the film images into their RGB components and plotting the average green intensity versus the change in temperature. The film was prepared in HEPES buffer (pH = 7.0) with 0 mM NaCl.

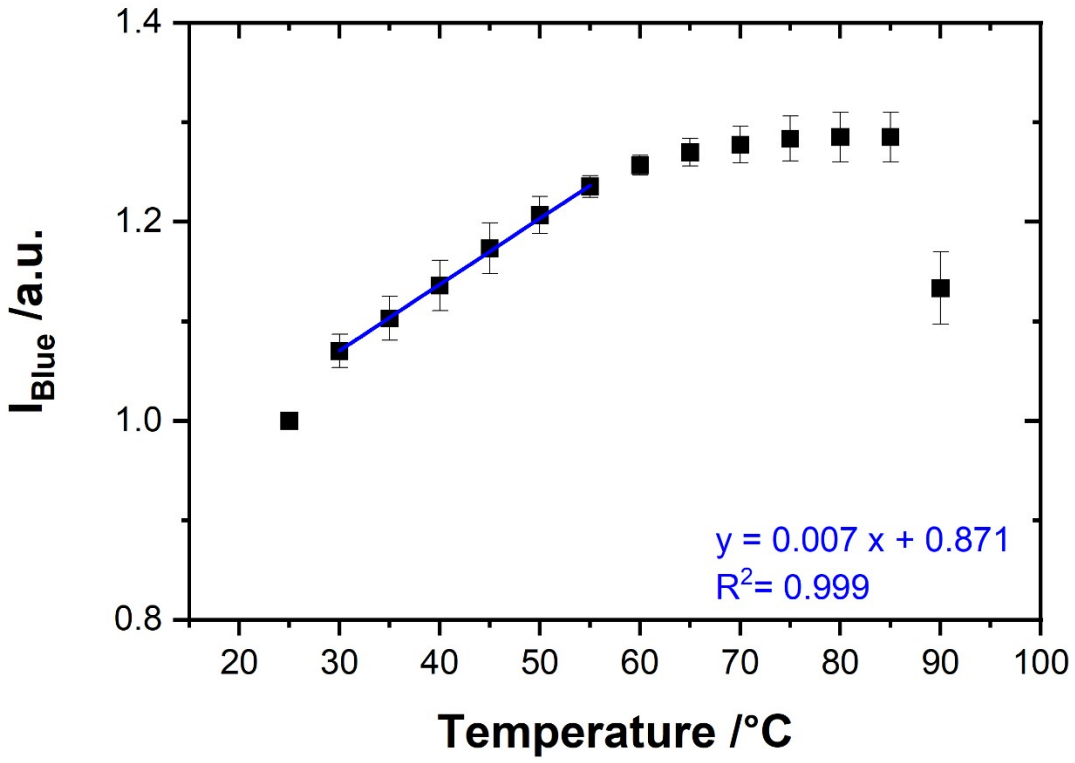

Figure S7: Fluorescent intensity obtained by disserting the images into their RGB components and plotting the average blue intensity versus the change in temperature. The film was prepared in HEPES buffer (10 mM, pH = 7.0) with 300 mM NaCl.

The change in the intensity of the blue channel, of films prepared in 300 mM NaCl and heated, versus the change in temperature is represented in **Figure S5.** The plot shows a linear range between 30 and 60 °C with absolute sensitivity of 0.006°C^{-1} and relative sensitivity of 0.6%°C^{-1} at 25°C.

Photostability of the prepared films:

The photostability of the prepared films was tested by irradiating the filoms for one hour under UV. The flureoscence intensity was monitored to assess any degradation in the signal. The results

shows excellent stability with the fluorescence signal showing only a minor decrease of approximately 5%. This result demonstrates that the films maintained thrir optical properties under prolonger UV exposure and would be suitable for longterm applications.

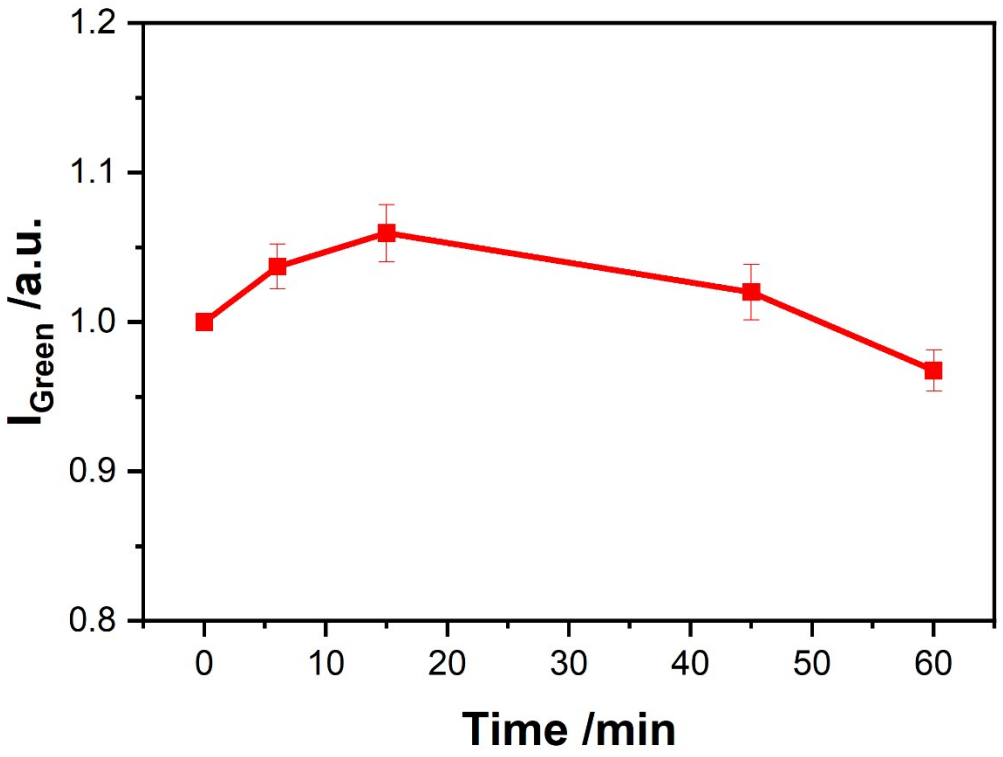

Figure S8: Fluorescence change of the PGA/PPE-CO_2-108 films upon exposure to continuous irradiation of UV light.