

SUPPORTING INFORMATION

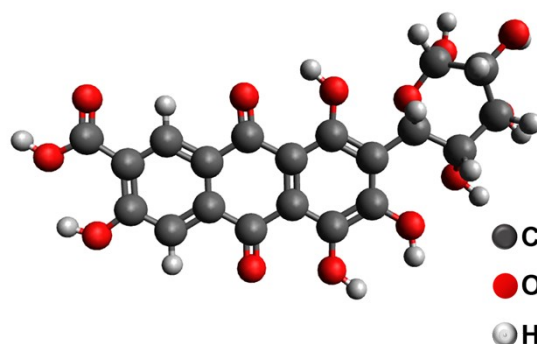
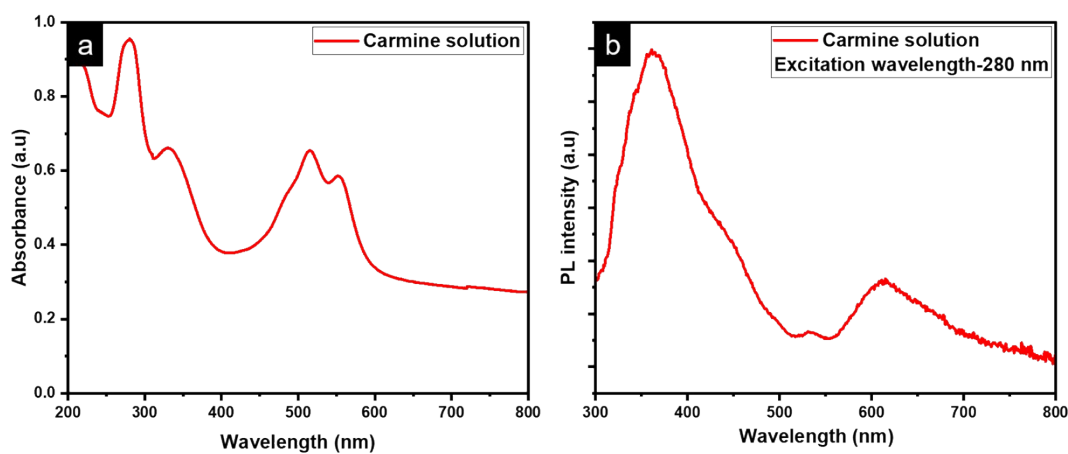


Fig.S1. Structure of Carmine dye molecule

Fig.S2. a) UV-Vis absorption spectra of carmine solution b) Photoluminescence spectra of Carmine solution



Sample	2 theta	FWHM	Crystallite size D(nm)	Lattice strain ($\epsilon_x 10^{-3}$)
Pure PVA	20.1536	0.944	8.547412	0.731981
0.304 mM	20.214	1.174	6.873521	0.913109
1.216 mM	20.21	1.1063	7.294101	0.86028
4.864 mM	20.208	1.43	5.642964	1.111883

Table S1. Crystallographic information of Pure and carmine incorporated PVA samples

Crystallite size (D) is calculated from the Debye Scherrer equation

$$D = \frac{n\lambda}{\beta \sin\theta}$$

n- Scherrer's constant (0.9)

λ -Wavelength of XRD (0.15406nm)

β - Full width half maximum

θ -Diffraction angle

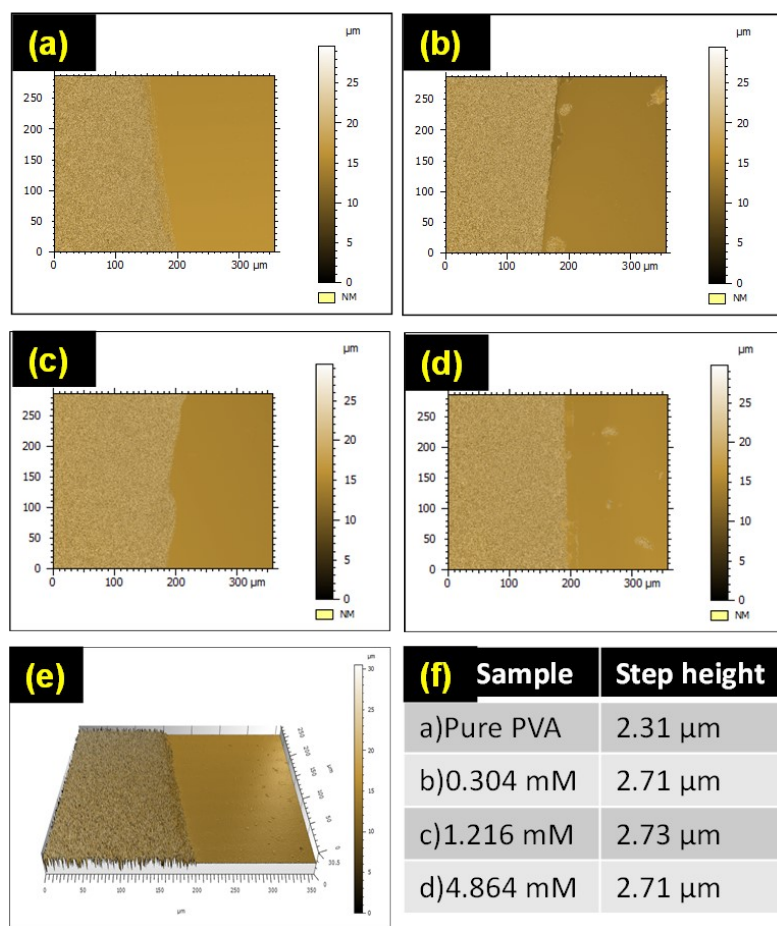
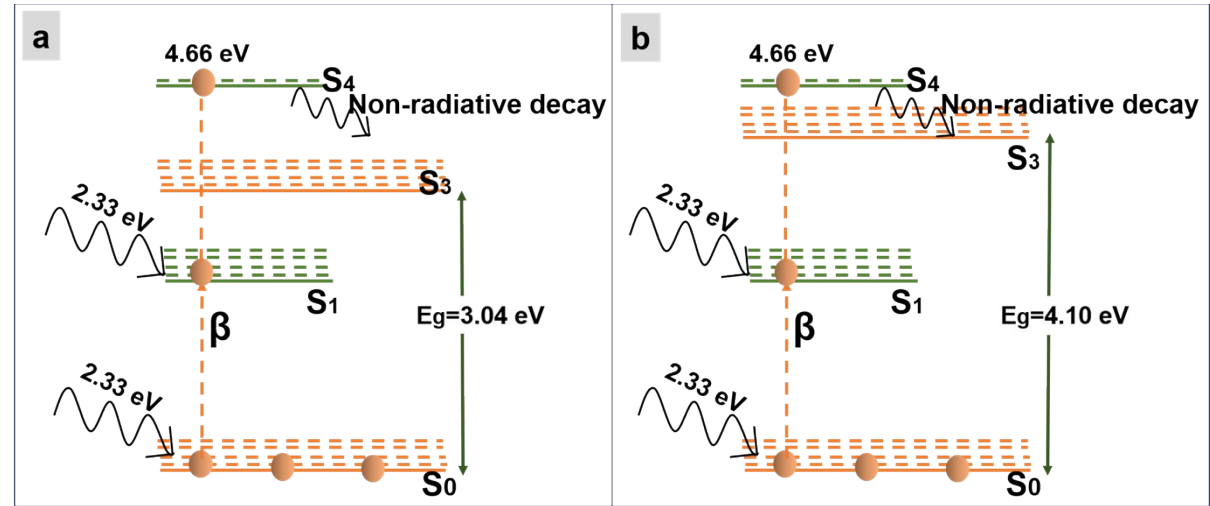


Fig.S3. Optical profilometry images of (a) unfilled PVA (b) films of carmine concentration 0.304 mM (c) films of carmine concentration 1.216 mM (d) films of carmine concentration 4.864 mM (e) cross-sectional view of the film of carmine concentration 4.864

Fig.S4. Illustration showing a) Sequential two-photon absorption of carmine in solution b) Sequential two- photon absorption in 1.216 mM sample



Dye	$\beta \times 10^{-10} \text{ m/W}$	References
Red beetroot	3.09	1
Curcumin	1.96	2
Spinach	0.87	3
neutral red	1.10	4
Quinazolinone	0.23	5
HC	0.72 ± 0.04	6
DTBT	1.05 ± 0.05	6
PCTB	1.22 ± 0.06	6
thiophene–imidazo[2,1-b][1,3,4]thiadiazole based azomethines	0.81	7
Carmine-PVA composite	3.10	Present work

Table.2. Comparison of nonlinear absorption with other literature

References:

- 1 A. Thankappan, S. Thomas and V. P. N. Nampoori, *Opt Mater (Amst)*, 2013, **35**, 2332–2337.
- 2 R. Fathima and A. Mujeeb, *Dyes and Pigments*, 2021, **189**, 109256.
- 3 K. Bouchouit, B. Derkowska, A. Migalska-Zalas, S. Abed, N. Benali-cherif and B. Sahraoui, *Dyes and Pigments*, 2010, **86**, 161–165.
- 4 M. George, C. I. Muneera, C. P. Singh, K. S. Bindra and S. M. Oak, *Opt Laser Technol*, 2008, **40**, 373–378.
- 5 J. Jia, W. Wang, Y. Cui, H. Dong, C. Luo, Y. Li, K. Cao and J. Gao, *Chem Phys Lett*, 2018, **708**, 201–209.
- 6 A. U. Habeeba, M. Saravanan, T. C. S. Girisun and S. Anandan, *J Mol Struct*, 2021, **1240**, 130559.
- 7 V. Kakekochi, U. Kumar D, N. P. P and K. Chandrasekharan, *Dyes and Pigments*, 2019, **167**, 216–224.