Strain sensing multi-stimuli responsive light emitting lanthanide-based hydrogels with tunable luminescence and fast self-recovery using metal-ligand and hydrophobic interaction.

SUPPORTING INFORMATION: ESI

Prachishree Panda[1], Agniva Dutta[1], Sourabh Pal[2], Debabrata Ganguly[3], Santanu Chattopadhyay[3], Narayan Chandra Das[3], Rajat K. Das*[1]

[1]Materials Science Centre, Indian Institute of Technology Kharagpur, Kharagpur, India

[2]Advanced Technology Development Centre, Indian Institute of Technology Kharagpur, Kharagpur, India
[3]Rubber Technology Centre, Indian Institute of Technology Kharagpur, Kharagpur, India

Correspondence

Rajat K. Das, Materials Science Centre, Indian Institute of Technology Kharagpur, Kharagpur, West Bengal 721302, India.

Email: rajat@matsc.iitkgp.ac.in

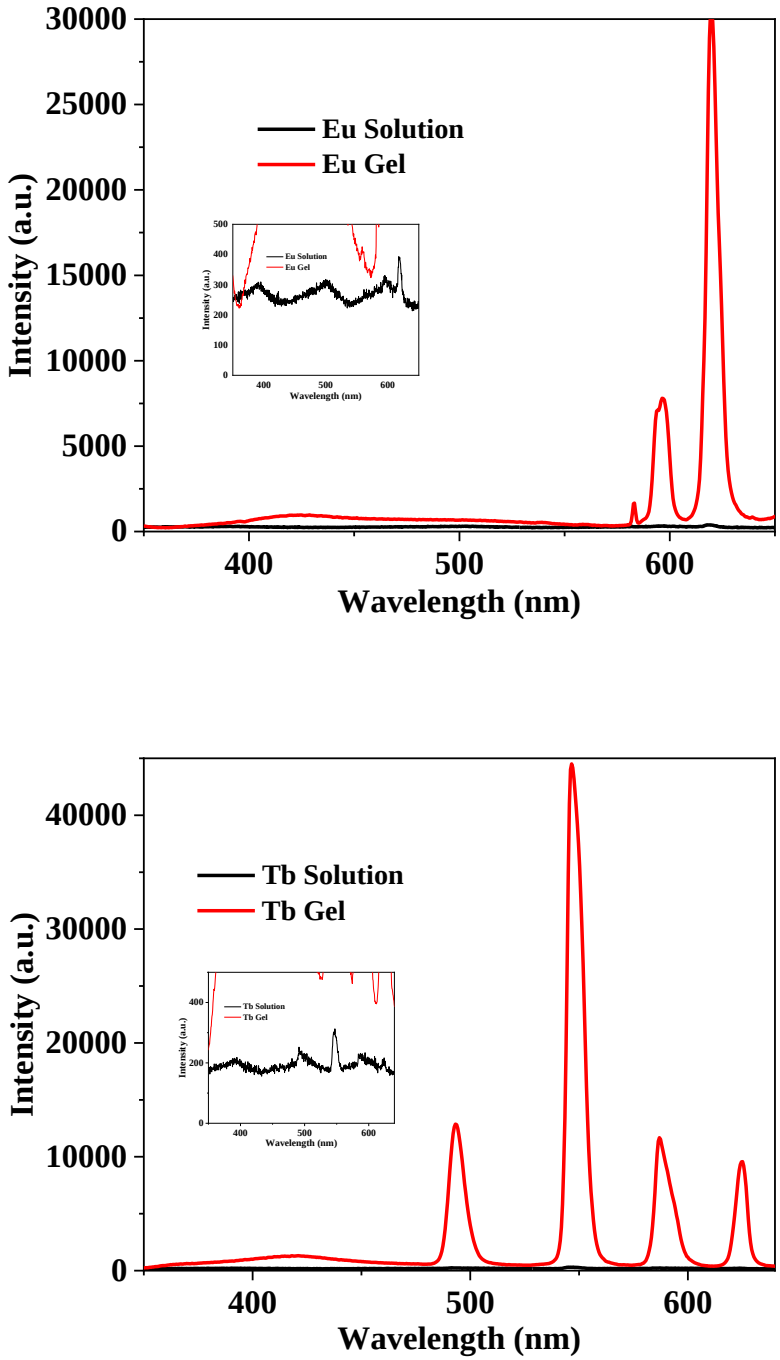

Figure S1. Emission spectra (λex = 330 nm) of the system in gel and solution state.

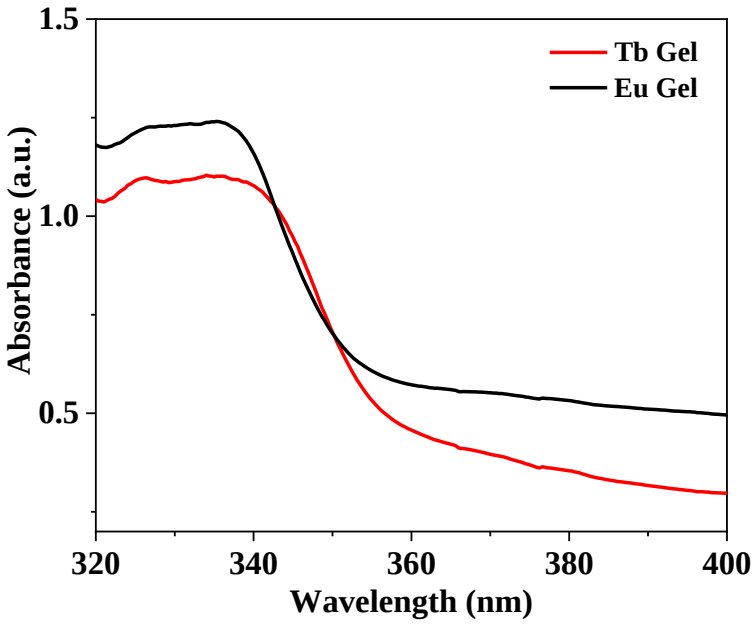

Figure S2. UV-vis absorption spectra of hydrogels.

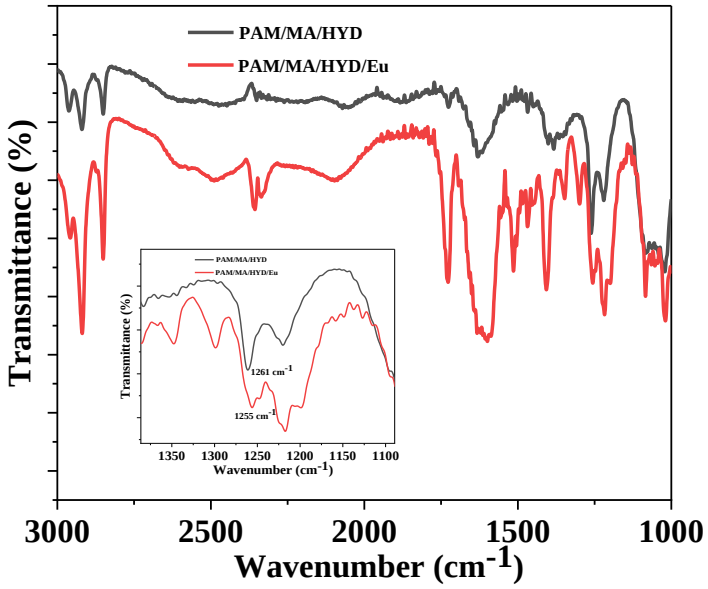

Figure S3. FTIR spectra of hydrogel in absence (black) and in the presence of Eu^{3+} ion.

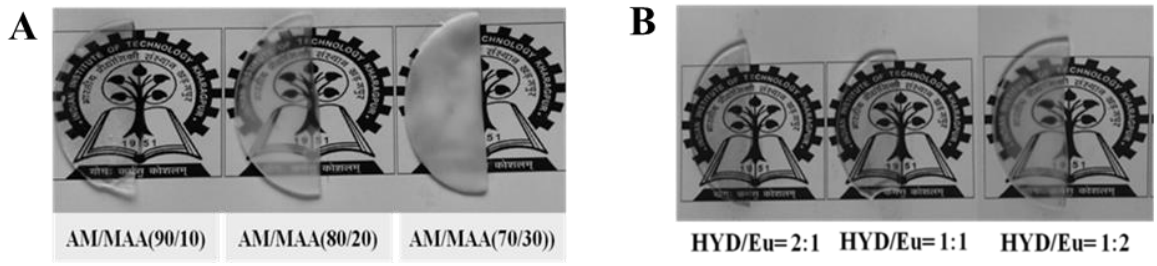

Figure S4. (A) Appearance of hydrogel samples synthesized with different ratio of methacylic acid to acrylamide, (B) Appearance of hydrogel samples synthesized with different ratio of hydrophobe to lanthanide ion (Eu^{3+}).

Table S1. Mechanical parameters of the hydrogel with different AM/MA ratio in presence of Ln^{3+} ion (Eu^{3+}).

AM/MA (Ratio)	Ultimate Stress (kPa)	Strain (%)	Stiffness (kPa)	Toughness (kJ/m^3)
90/10	134.8±3.44	560.27±74.3	47.14±4.13	844.14±65.57
80/20	156.04±4.95	479.88±56.16	50.19±5.3	321.57+/-21.64
70/30	200±2.89	488.99±19.25	53.55±1.13	403.16±18.27
100/0	42.38±10	612.38±51.32	18.23±2.65	145.65±37.7

Table S2. Mechanical parameters of the hydrogel with different Hydrophobe to Ln^{3+} (Eu^{3+}) ratio.

Hydrophobe/Ion	Ultimate tensile stress (kPa)	Strain (%)	Stiffness (kPa)	Toughness (kJ/m^3)
1:2	484.8±5.6	562.68±96.6	136.98±15.5	1164±15.8
1:1	250.5±7.8	591.28±20.47	93.76±22.8	807.5±81.3
2:1	134.8±3.44	560.27±74.32	47.14±4.13	844.1±65.5

Table S3. Mechanical parameters of the hydrogel with different Hydrophobe concentrations.

Samples	Ultimate tensile stress (kPa)	Strain (%)	Stiffness (kPa)	Toughness (kJ/m^3)
0.2 Hyd/ Eu	130.48±0.14	532.43±40.24	36.505±3.16	293.32±18.75
0.5 Hyd/Eu	484.8±5.6	562.68±96.6	136.98±15.5	1164±15.8
1.0 Hyd/Eu	269.15±5.01	331.25±17.61	145.47±18.89	433.5±4.45

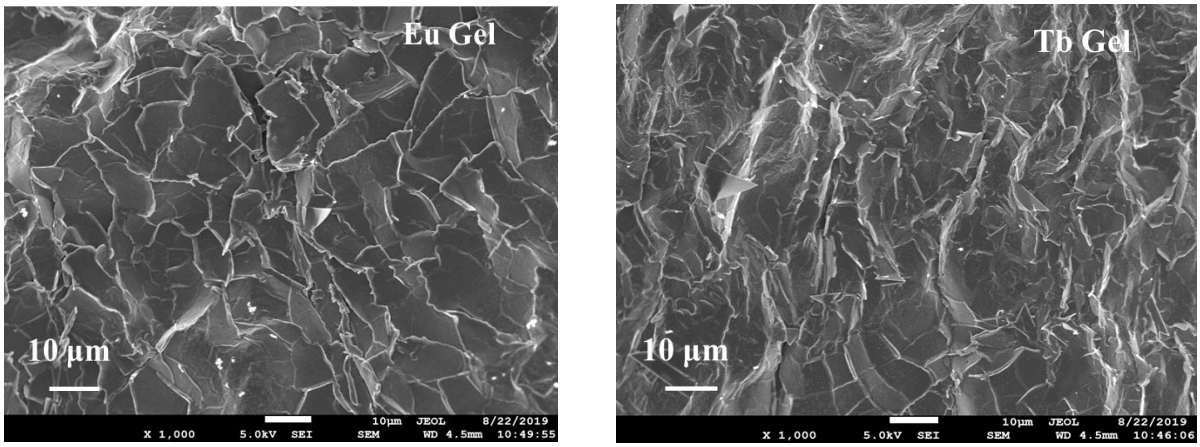

Figure S5. FESEM images of Eu^{3+} and Tb^{3+} hydrogels.

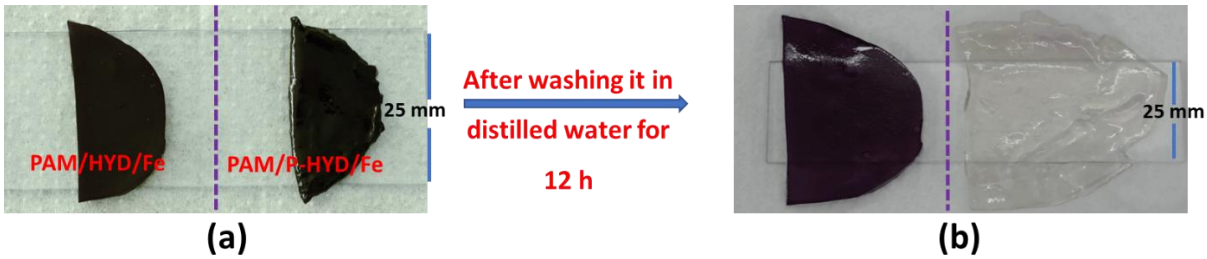

Figure S6. Pictures of PAM/HYD/Fe and PAM/P-HYD/Fe gels films (A) as prepared, (B) after washing in distilled water for 12 h.

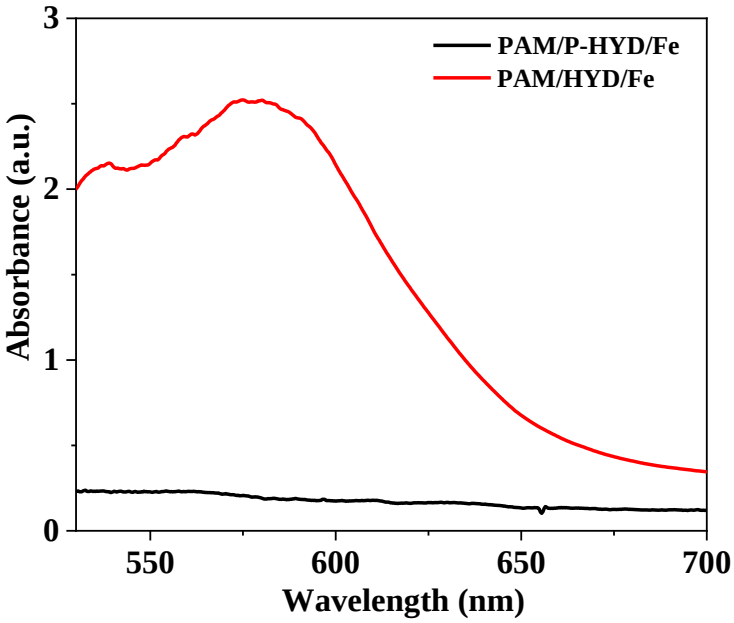

Figure S7. The absorption spectra of air-dried hydrogels of PAM/P-HYD/Fe (black) and PAM/HYD/Fe (red).

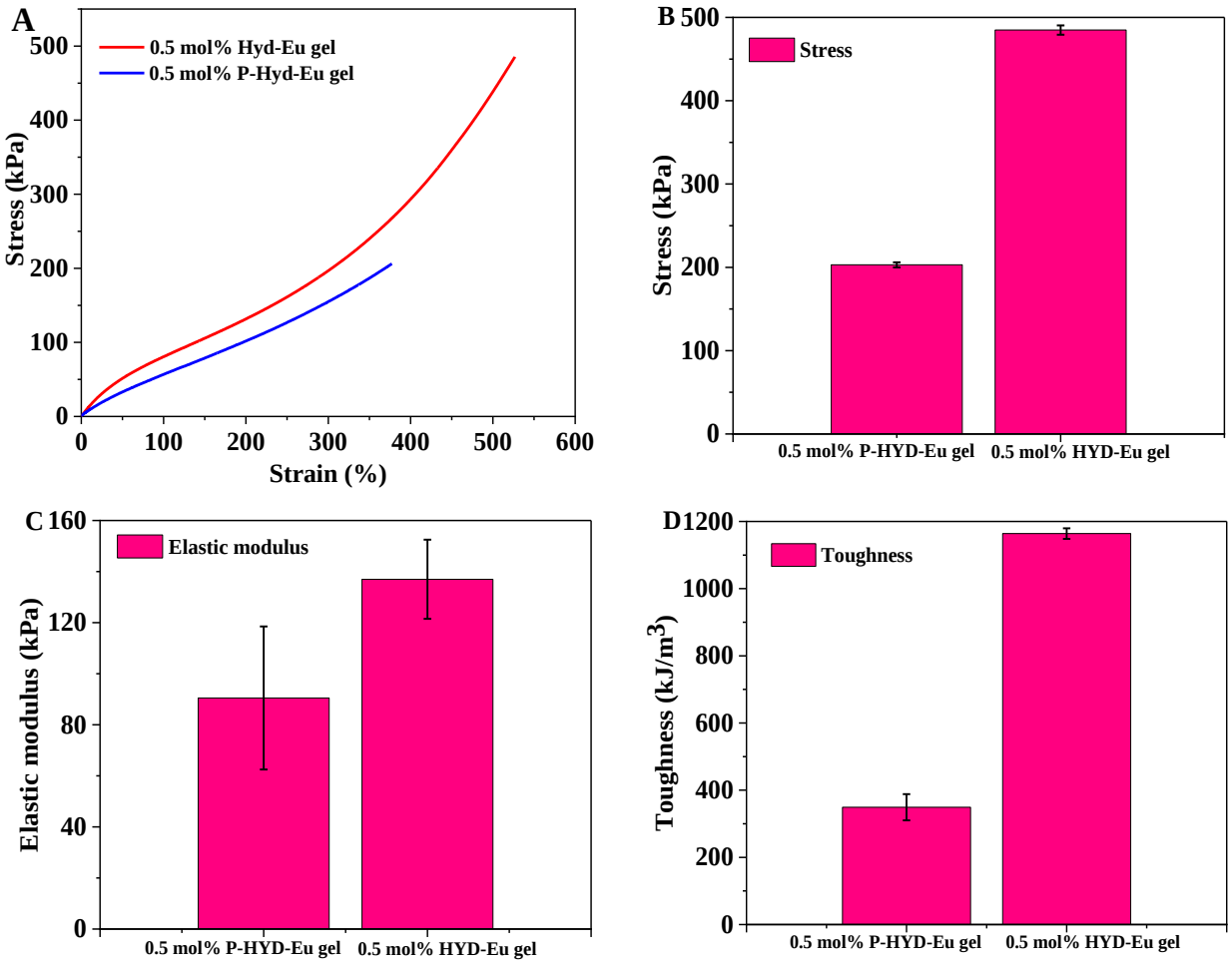

Figure S8. Tensile stress-strain graph for 0.5 mol% P-HYD-Eu gel and 0.5 mol% HYD-Eu gel. Comparative study for (B) stress, (C) elastic modulus and (D) toughness. Error bars represent standard deviations from the mean (n = 3).

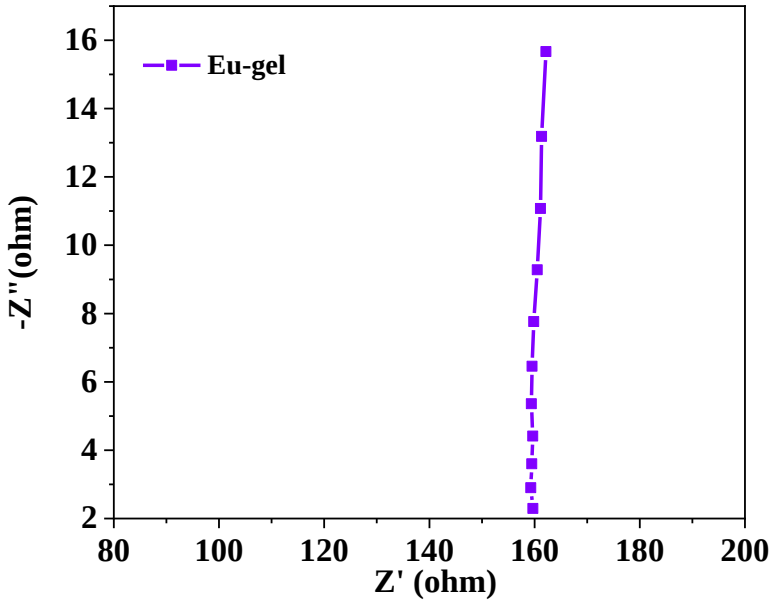

Figure S9. Nyquist plot of Eu hydrogel.

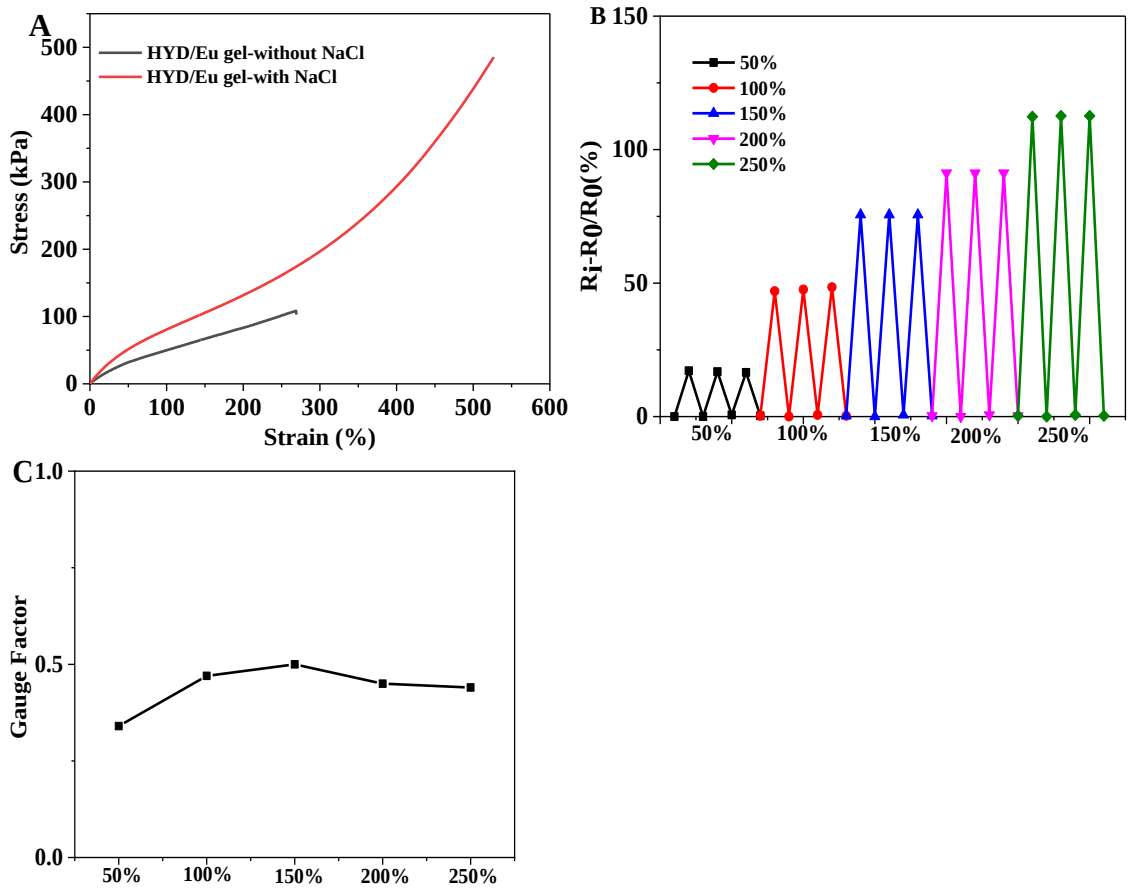

Figure S10. For the Eu^{3+} hydrogel prepared in the absence of NaCl: (A) Tensile stress-strain experiment, (B) relative resistance change % by repeated tensile loading-unloading to different strains, (C) Gauge factor using hydrogel based resistive sensor.