Supplementary Material for

Development of a Semiconducting Supramolecular Copper(II)-Metallogel for Antimicrobial and Microelectronic Device Applications

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Rheological Analysis:

The strain-sweep experiment, performed at a constant angular frequency of 6.283 rad/s, provided insights into the gel's mechanical response under varying strain conditions. The results, depicted in Fig. S1, highlight the Cu-IPA metallogel's ability to maintain its structure and mechanical integrity within specific strain limits, further emphasizing its high tolerance and gel stability.

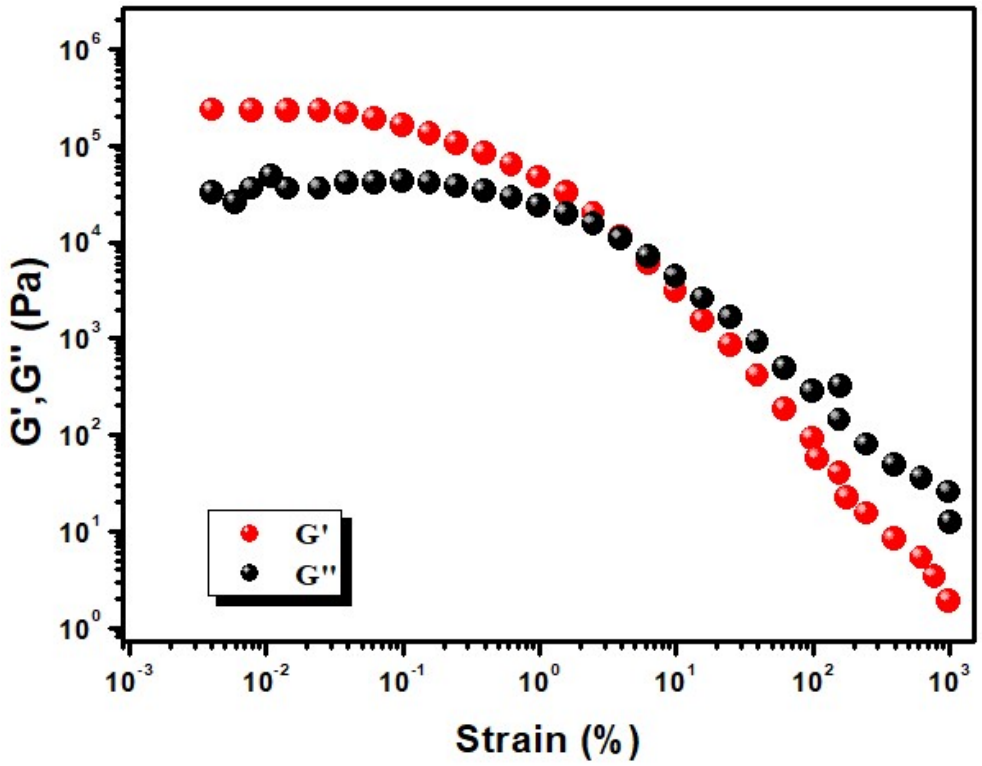

Fig. S1. Strain-sweep measurements of Cu-IPA metallogel performed at a constant frequency of 6.283 rad/sec.

Optical Property:

In order to ascertain the optical band gap, the optical absorbance spectra of the synthesized metallogel were measured. The UV-Vis absorption spectrum of the synthesized material between 200 and 800 nano-meters is shown in Fig. S2 inset. The metallogel's direct optical band gap energy is determined using Tauc's equation[1]

$$(\alpha h\nu)^2 = c(h\nu - E_g) \qquad \text{(S1)}$$

where α is the absorption coefficient, E_g is the optical band gap energy, h is Planck's constant, υ is frequency and c refer a constant. The band gap energy due to direct allowed

transitions in the metallogel is estimated as 3.76 eV (Fig. S2) considering highest absorption edge in Tauc's plot.

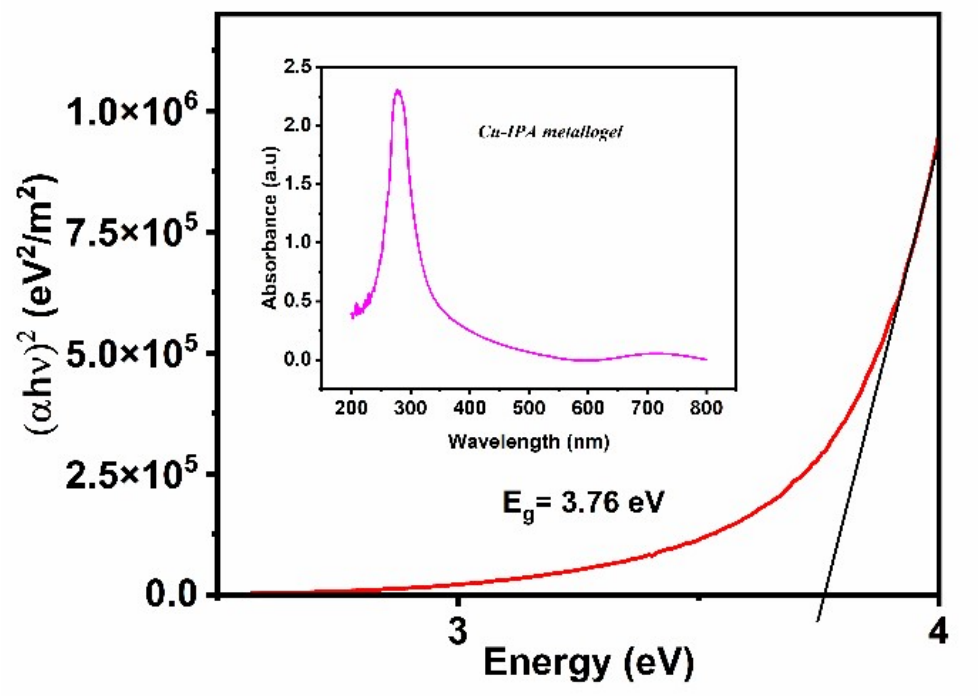

Fig. S2. Tauc's plot to evaluate the direct allowed band gap energy and (inset) UV-Vis absorption spectra of the metallogel.

Thermionic emission theory:

For the very purpose the following equations of thermionic emission is employed where series resistance of the configuration is also taken into consideration.[2]

$$I = I_{sat}(e^{\frac{q(V-IR_s)}{\eta kT}} - 1) \quad \text{(S2)}$$

Where I_{sat} represents the saturation current density, q is the electronic charge, V symbolizes the voltage across the diode, n is the ideality factor, k denotes the Boltzmann constant and T is the absolute temperature. IR_s is the voltage drop across the configuration with a series resistance of R_s. The saturation current density I_{sat} can be expressed as:

$$I_{sat} = AA^*T^2e^{\frac{-q\phi_b}{kT}} \quad \text{(S3)}$$

Where A* is the effective Richardson constant and $\emptyset_b$ is the formed barrier height between Al/Cu-IPA-metallogel interface. Here, the effective diode area is considered as 7.065×10^{-6} m^2. The effective Richardson constant is taken as 1.201×10^6 $AK^{-2}m^{-2}$ using standard value of the constant.

Reference:

1. A. Dolgonos, T. O. Mason and K. R. Poeppelmeier, *J. Solid State Chem*., 2016, **240**, 43-48.
2. P. Das, B. Pal, J. Datta, M. Das, S. Sil and P. P. Ray, *J. Phys. Chem. Solids*, 2021, **148**, 109706.