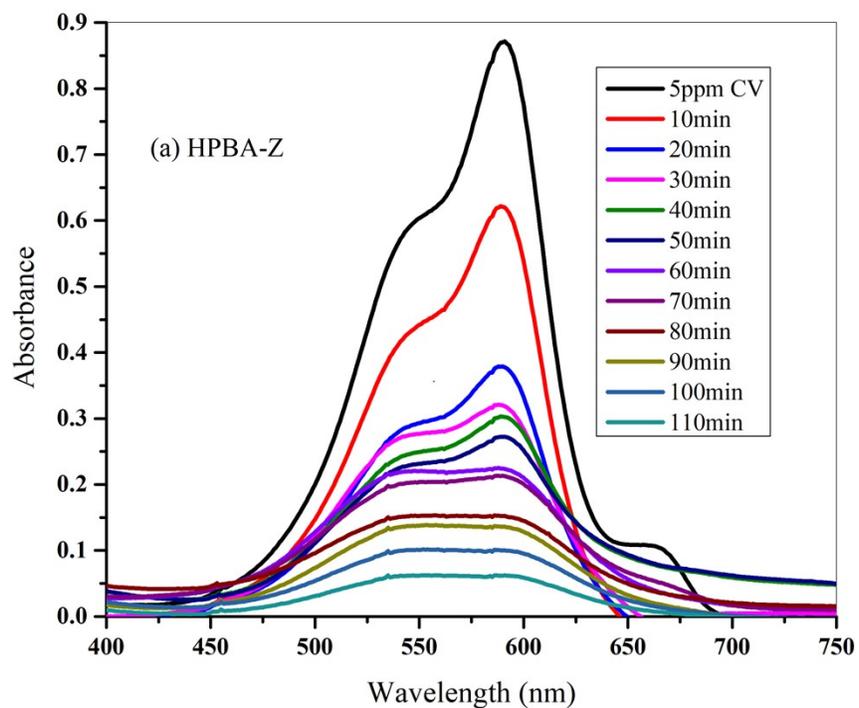


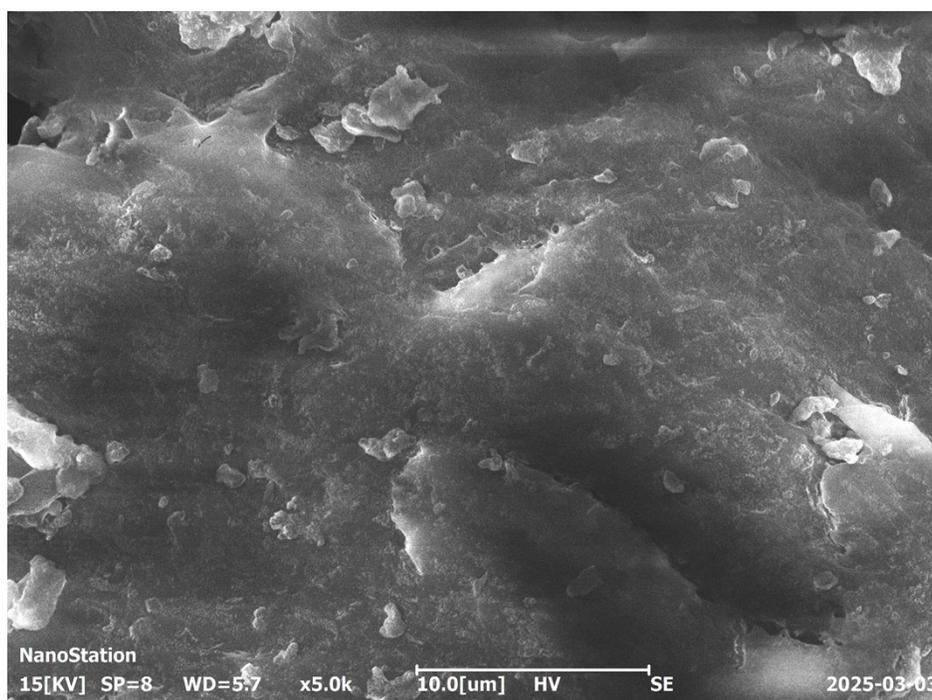
Supporting Information file for manuscript

Table S1. This table shows the major absorption peaks of FTIR for poly(Am-co-BA)@PVA, ZnO and CuO doped nanocomposite hydrogel network.

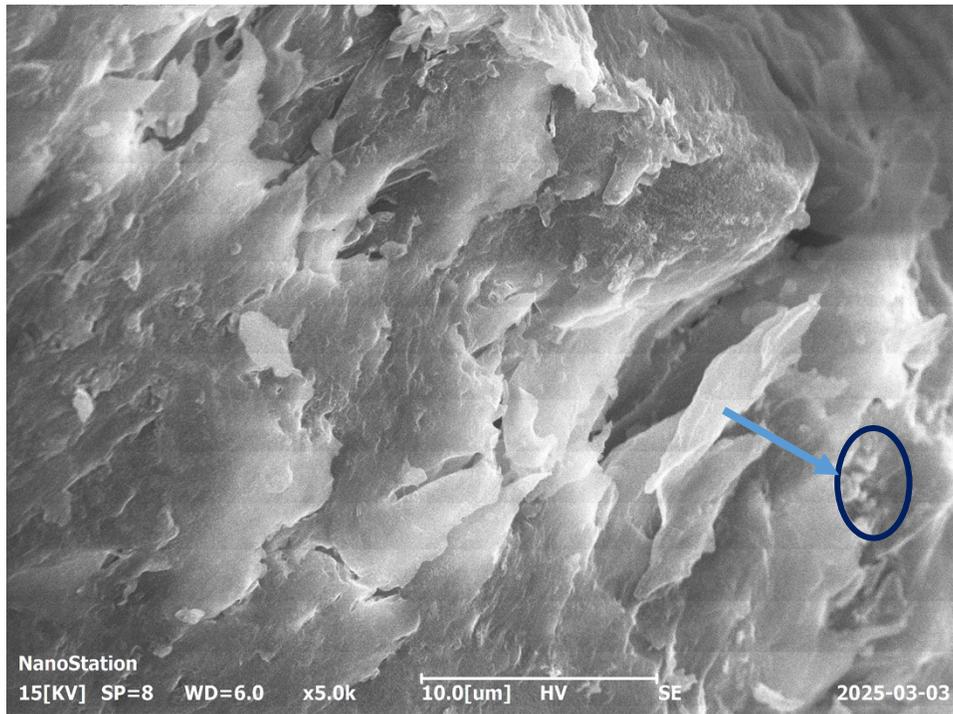
Wavenumber (cm ⁻¹)	Vibrations	Origin of peaks	Remarks
3350–3330	O–H and N–H stretching	PVA and polyacrylamide hydroxyl/amino groups	Broad band, indicates strong hydrogen bonding and cross-linked hydrogel network
2930–2915	C–H stretching (–CH ₂ –, –CH ₃)	Butyl acrylate and PVA backbone	Confirms alkyl presence in polymer chain
1650–1647	C=O stretching (amide I)	Acrylamide units (polyacrylamide network)	Confirms amide incorporation; overlaps with ester C=O of BA
1450–1467	CH ₂ bending / scissoring	Aliphatic chain deformation	Suggests flexible alkyl groups in hydrogel
1215–1218	C–O–C / C–N stretching	Ester and amide linkages	Indicates interpenetration and copolymer formation
1080–1081	C–O stretching	PVA and butyl acrylate ester groups	Confirms successful crosslinking of PVA chains
828–827	C–H out-of-plane bending	Alkene or substituted CH vibrations	Minor feature, confirms polymeric backbone integrity
580–590	Metal–O vibration	Cu–O or Zn–O stretching in HPBA–C and HPBA–Z	Confirms nanoparticle incorporation in hydrogel matrix



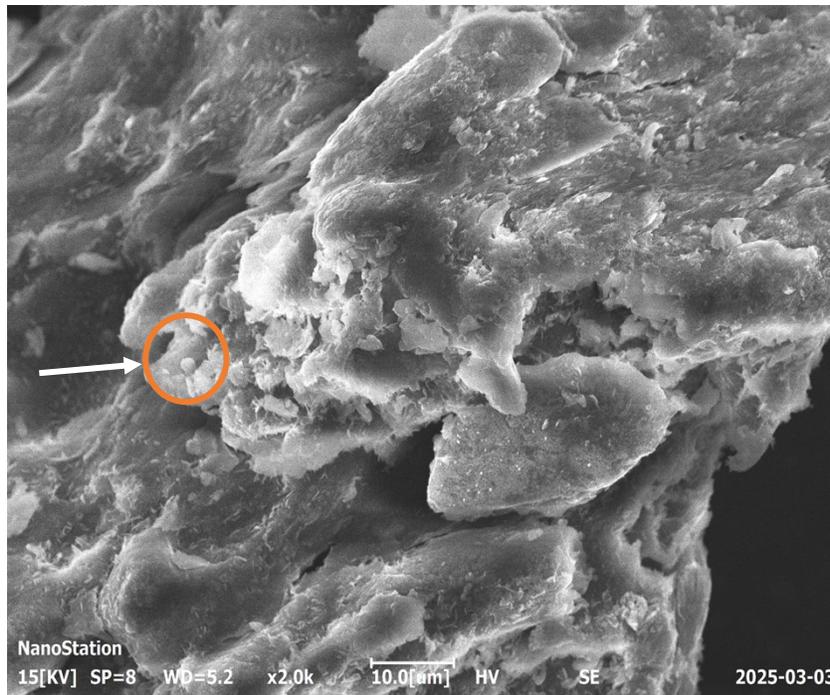
S3. SEM images of pure hydrogel, CuO-doped hydrogel and ZnO-doped hydrogel nanocomposites.



(a) Cross sectional SEM image of pure hydrogel

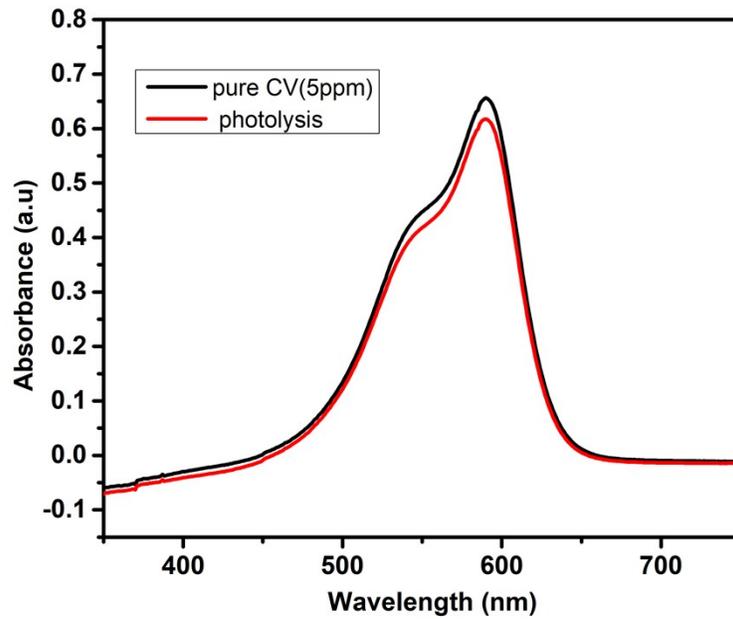


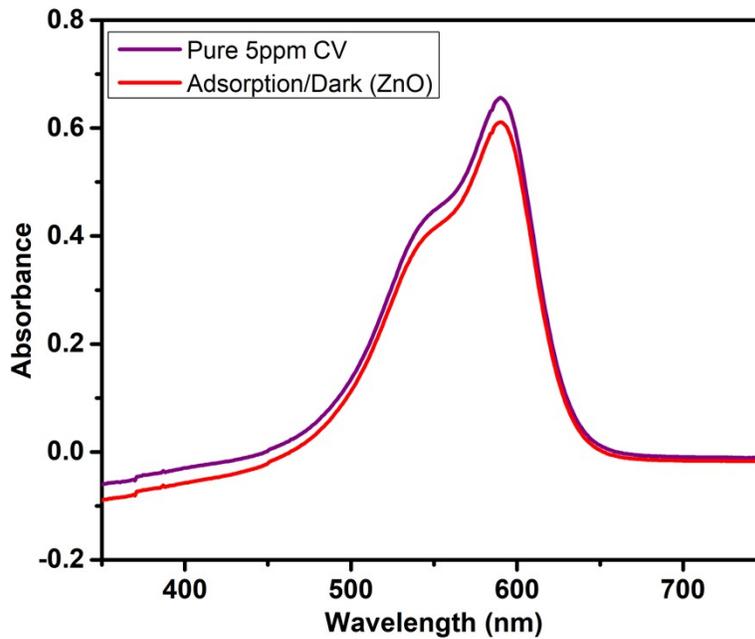
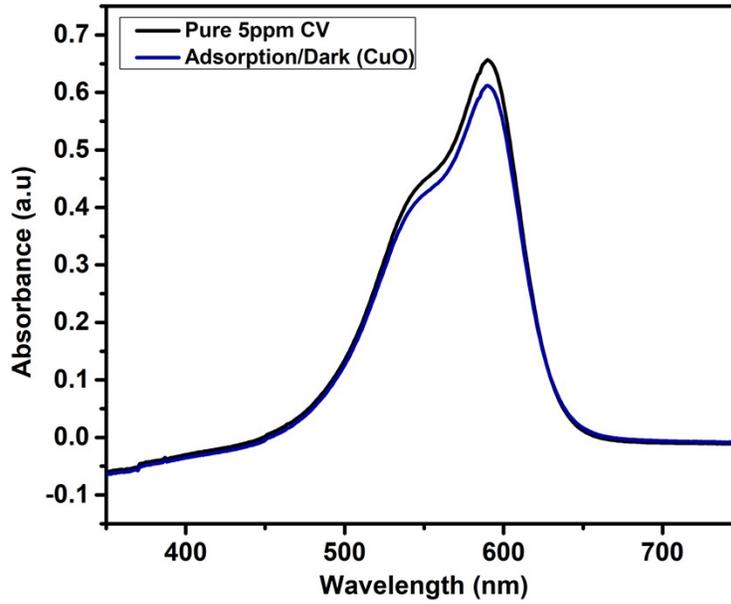
(b) Cross sectional SEM image of ZnO-doped hydrogel



(c) Cross sectional SEM image of CuO-doped hydrogel

S4 UV graphs along raw data for pH study, photolysis, adsorption study of ZnO-doped hydrogel and CuO-doped hydrogel.





S5 XRD raw data for ZnO-doped (HPBA-Z) hydrogel and CuO-doped (HPBA-C) hydrogel.

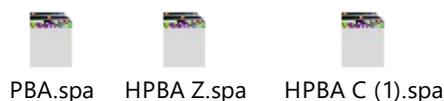


HPBA-C#3##20250409-111814_100.mdi



HPBA-Z#4##20250409-115027_100.mdi

S6. FTIR raw data for barren (PBA) (no photocatalyst), and ZnO-doped (HPBA-Z) hydrogel and CuO-doped (HPBA-C) hydrogel.



S7. To show the reliability and reproducibility of the results.

In this study, each photocatalytic experiment was performed once under firmly same and optimized settings due to instrumental and sample limitations. However, the experimental procedure was carefully standardized, and initial optimization trials were performed to confirm reproducibility and reliability of the results. Multiple absorbance readings were noted at each irradiation interval to minimize instrumental error and confirm stability of the measurements. Therefore, while standard deviation values could not be statistically calculated, the observed trends and performance comparisons between CuO- and ZnO-doped hydrogel nanocomposites remain reliable and representative. Future work will include triplicate measurements and statistical error analysis to further authenticate the photocatalytic data.

S8 BET raw data for CuO and ZnO-doped hydrogel composites



4.PDF

CuO



5.PDF

ZnO