

Supplementary Information

Pyridinic N anchored Ag and Au hybrids for detoxification of Organic pollutants

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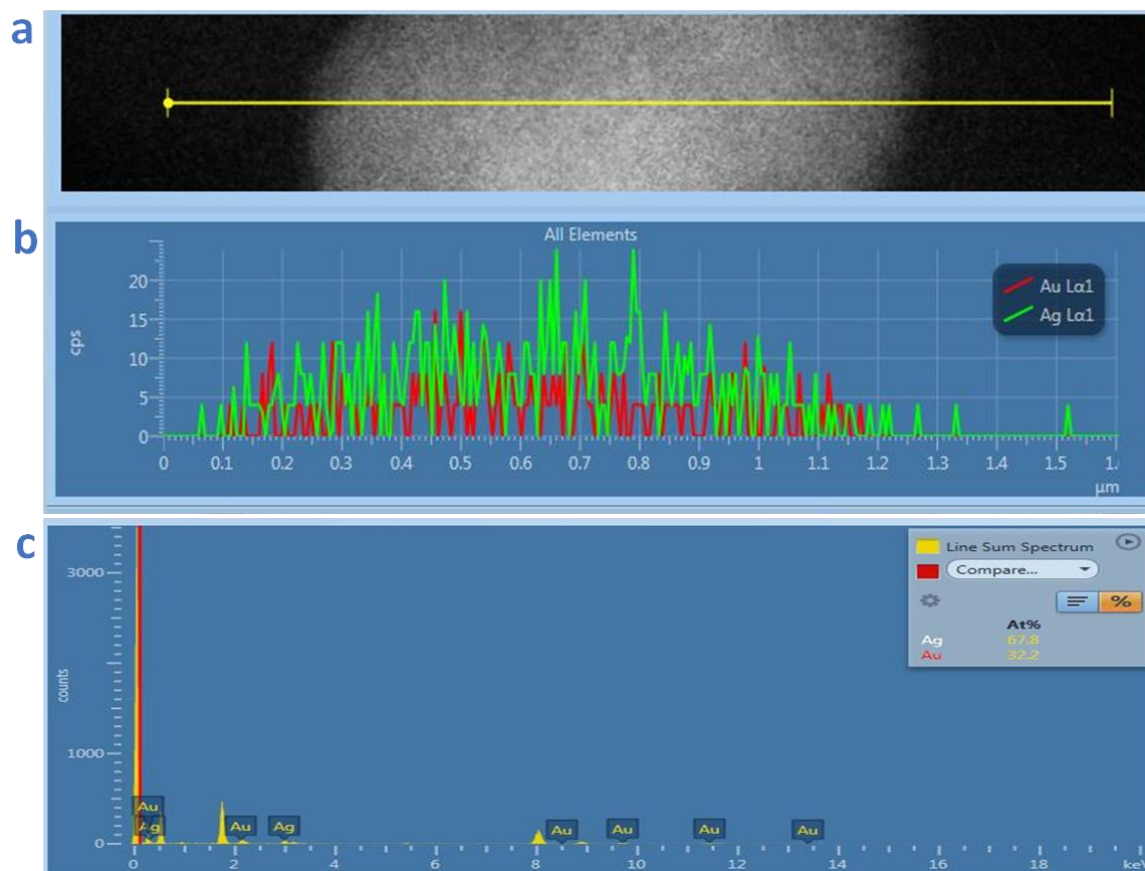
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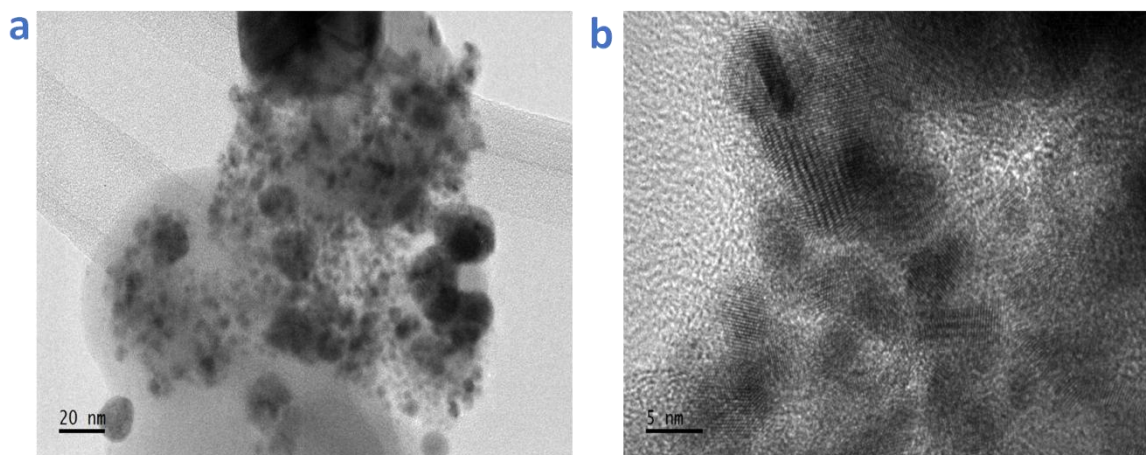
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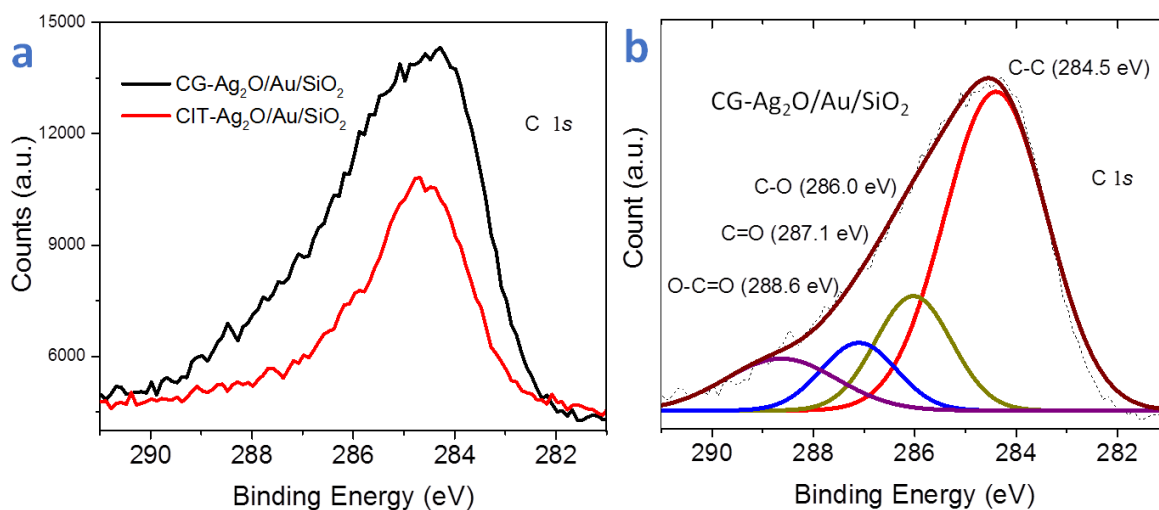
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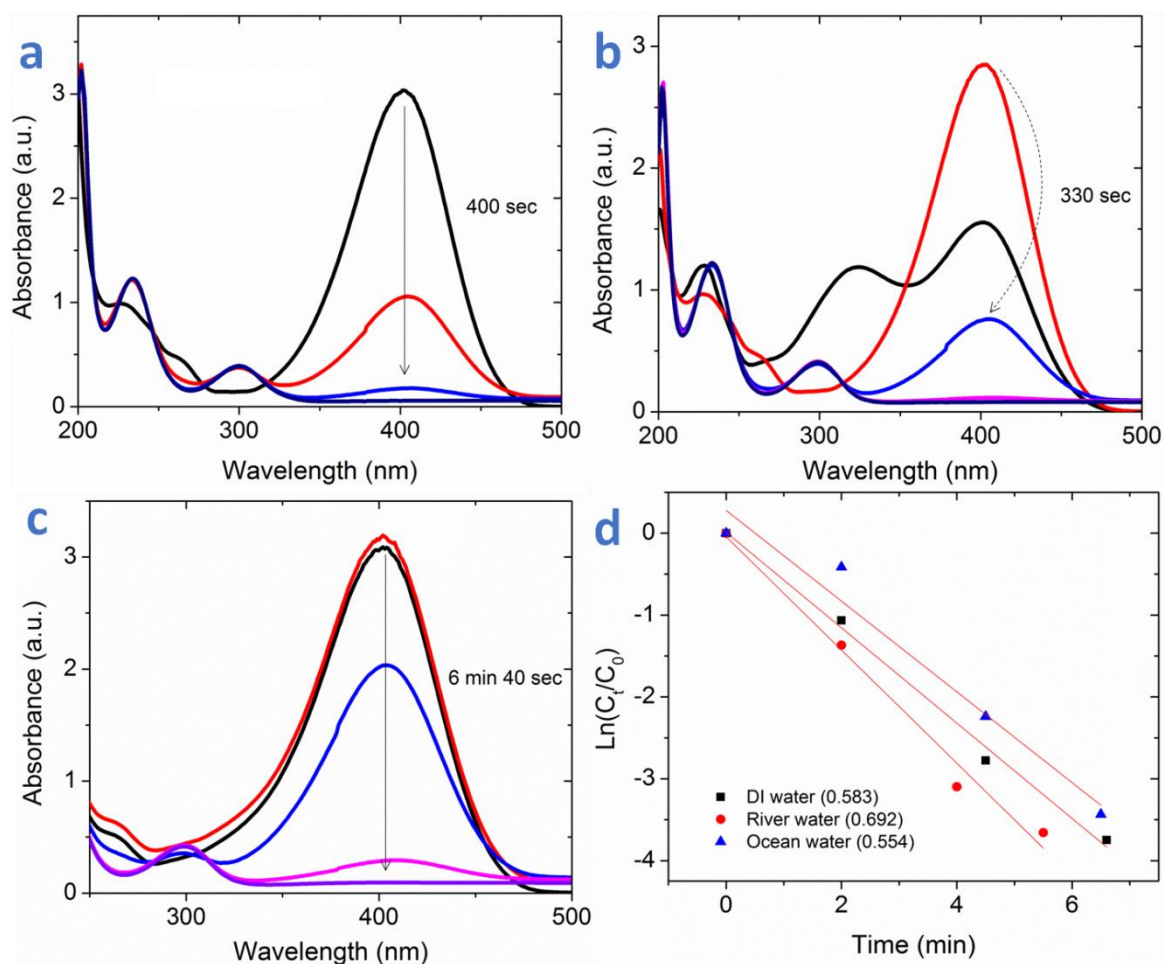
Supplementary Figure 1. (a-c) Line mapping and their corresponding Ag and Au signals of the fabricated CG-Ag₂O/Au-SiO₂ hybrids.



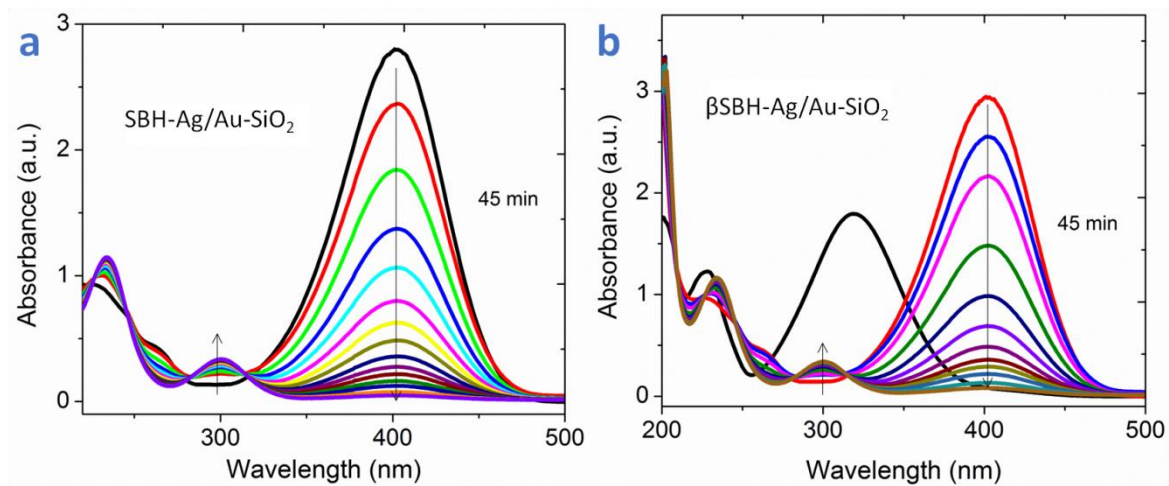
Supplementary Figure 2. (a) TEM (scale bar_20 nm), and (b) HR-TEM of the fabricated CIT-Ag₂O/Au-SiO₂ hybrids(scale bar_5 nm).



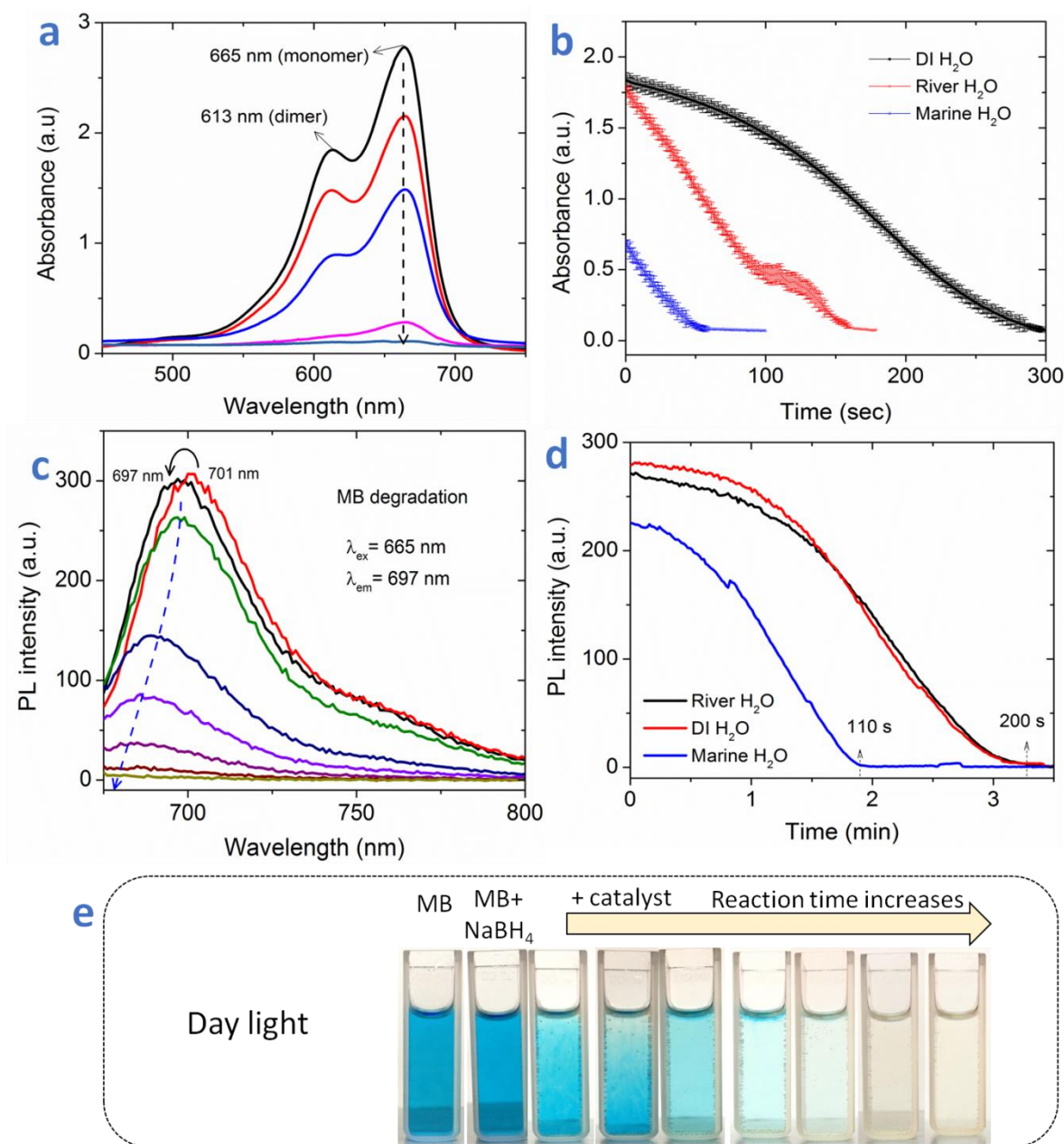
Supplementary Figure 3. High resolution deconvoluted XPS spectra of (a) C 1s of CG-Ag₂O/Au-SiO₂ and CIT-Ag₂O/Au-SiO₂, and (b) C 1s deconvoluted spectra of CG-Ag₂O/Au-SiO₂.



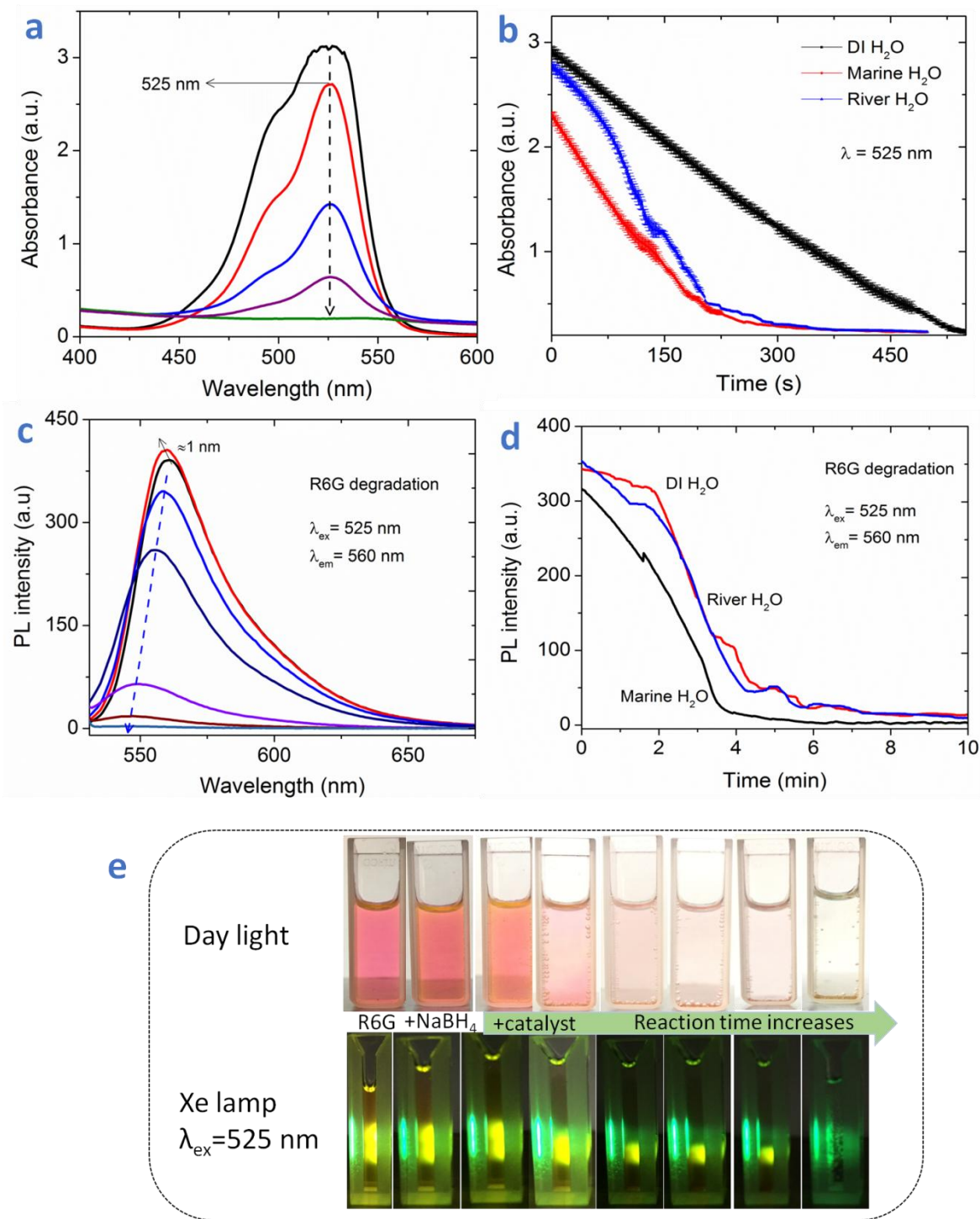
Supplementary Figure 4. Time-dependent UV-visible absorbance spectra of the catalytic reduction of 4-nitrophenol to 4-aminophenol using CIT-Ag₂O/Au-SiO₂ in (a) distilled, (b) river, (c) seawater spiked samples, and the corresponding (d) kinetics of the reaction using pseudo first order reaction ($\ln(C_t/C_0) = -kt$).



Supplementary Figure 5. Time-dependent UV-visible absorbance spectra of the catalytic reduction of 4-nitrophenol to 4-aminophenol using (a) SBH-Ag/Au-SiO₂ and (b) β SBH-Ag/Au-SiO₂.

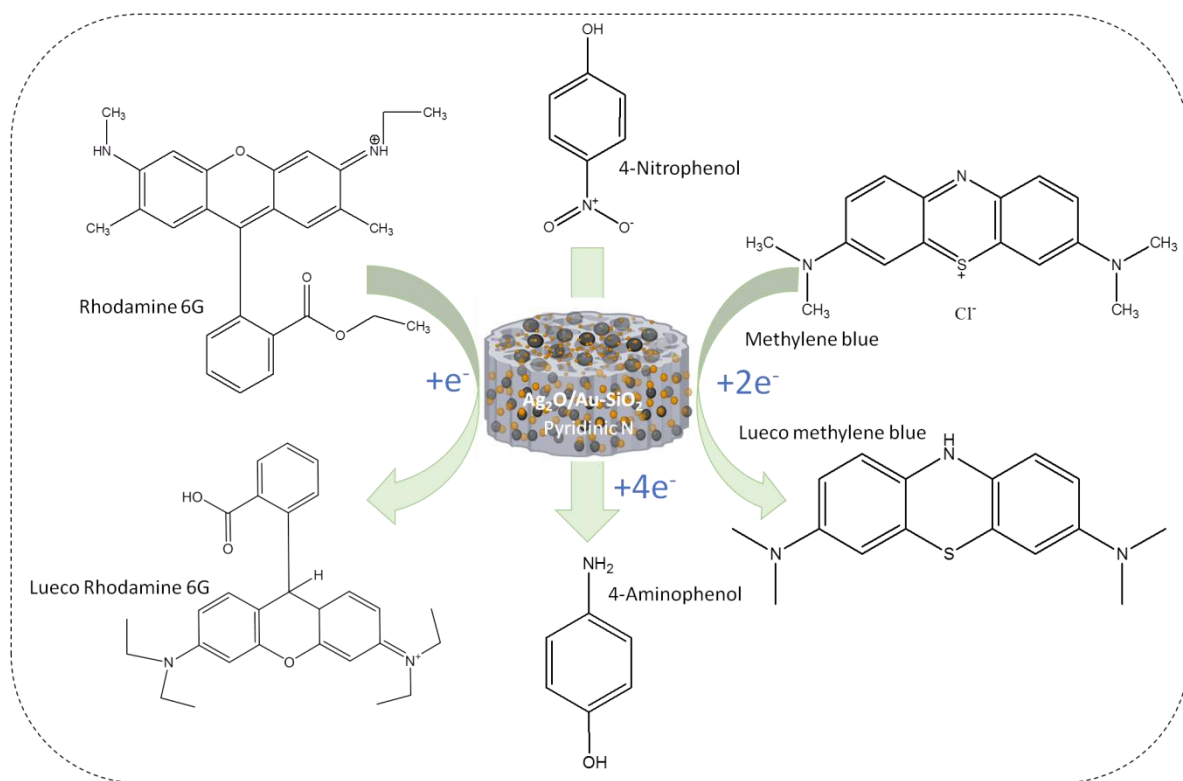


Supplementary Figure 6. Time-dependent UV-visible absorbance spectra of the catalytic degradation of methylene blue using CG-Ag₂O/Au-SiO₂ in (a) deionized water, (b) time vs. absorbance intensity of deionized, river, and marine water spiked samples, and the time-dependent photoluminescence spectra of MB in (c) deionized water, (c) time vs. PL intensity of deionized, river, and marine water spiked samples, the corresponding (e) digital photographs under day light.

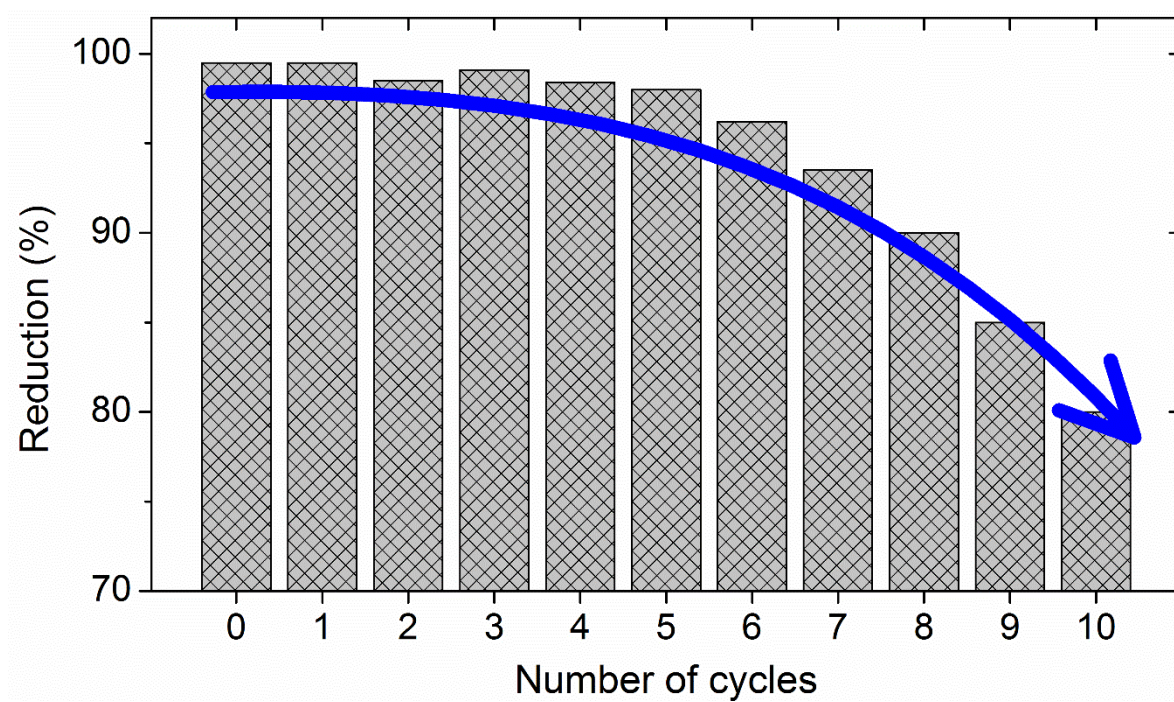


Supplementary Figure 7. Time-dependent UV-visible absorbance spectra of the catalytic degradation of rhodamine 6G using CG-Ag₂O/Au-SiO₂ in (a) deionized water, (b) time vs. absorbance intensity of deionized, river, and marine water spiked samples, and the time-

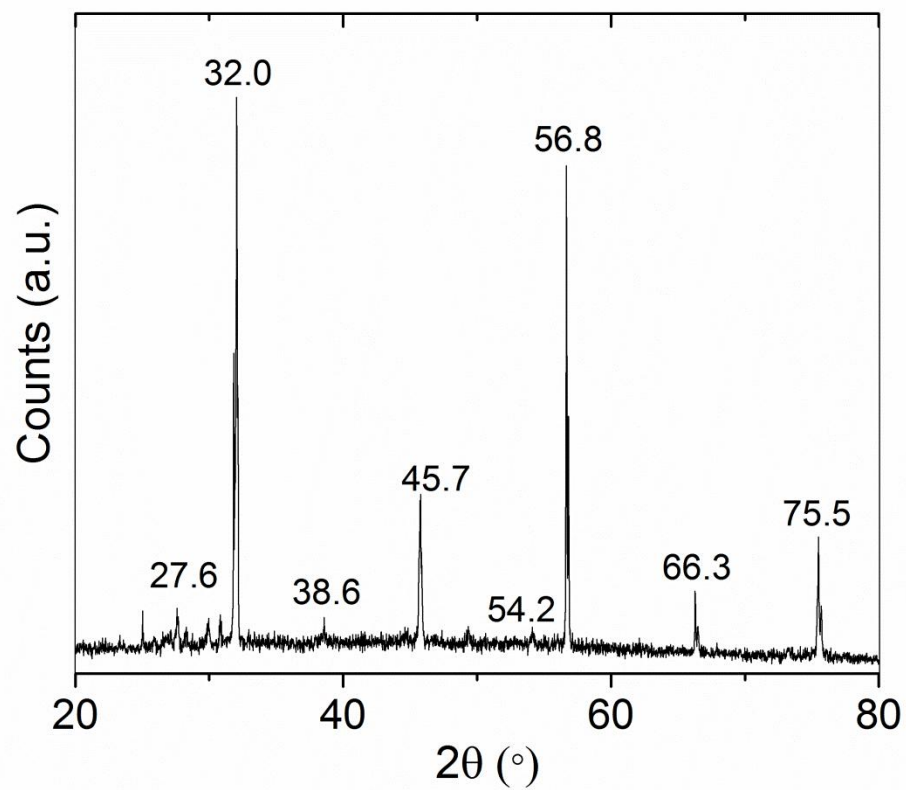
dependent photoluminescence spectra of R6G in (c) deionized water, (d) time vs. PL intensity of deionized, river, and marine water spiked samples, the corresponding (e) digital photographs under day light and Xenon lamp with 525 nm excitation, respectively.



Supplementary Figure 8. Catalytic reduction of 4-nitrophenol to 4-aminophenol and degradation of methylene blue and rhodamine 6G to their non-toxic products using CG-Ag₂O/Au-SiO₂ hybrids.



Supplementary Figure 9. Bar graph represents the reusability of CIT-Ag₂O/Au-SiO₂ hybrids for the reduction of 4-nitrophenol up to 10 cycles.



Supplementary Figure 10. XRD spectrum of used CG-Ag₂O/Au-SiO₂ hybrids catalyst (after 15 successive cycles) for the 4-nitrophenol reduction.

Supplementary Table 1. Adsorption Energy (E_{ads}), charge ($|e|$) and Fermi energy (eV) for the optimized catalytic systems

Catalyst	Ag ₂ O/SiO ₂	Au/SiO ₂	Au/SiO ₂ /4-NP	Ag ₂ O/SiO ₂ /4-NP	N-Au/SiO ₂ /4-NP	N-Ag ₂ O/SiO ₂ /4-NP
Adsorption energy (eV)	-0.96	-2.72	-3.34	-1.05	-17.43	-18.21
Charge ($ e $)			Au: 10.827 4-NP: 0.431	Ag: 10.309 4-NP: 0.122	Au: 10.658 4-NP: 0.320 ; N: 5.665	Ag: 10.495 4-NP: 0.136 ; N: 4.943
Fermi Energy (eV)			-2.0035	-2.7381	-2.2607	-2.2811