

Supplementary Information

Green synthesis of silver and copper-doped zinc oxide nanoflowers using *Leucophyllum frutescens* leaf extract for photodegradation of methylene blue dye and antibacterial applications

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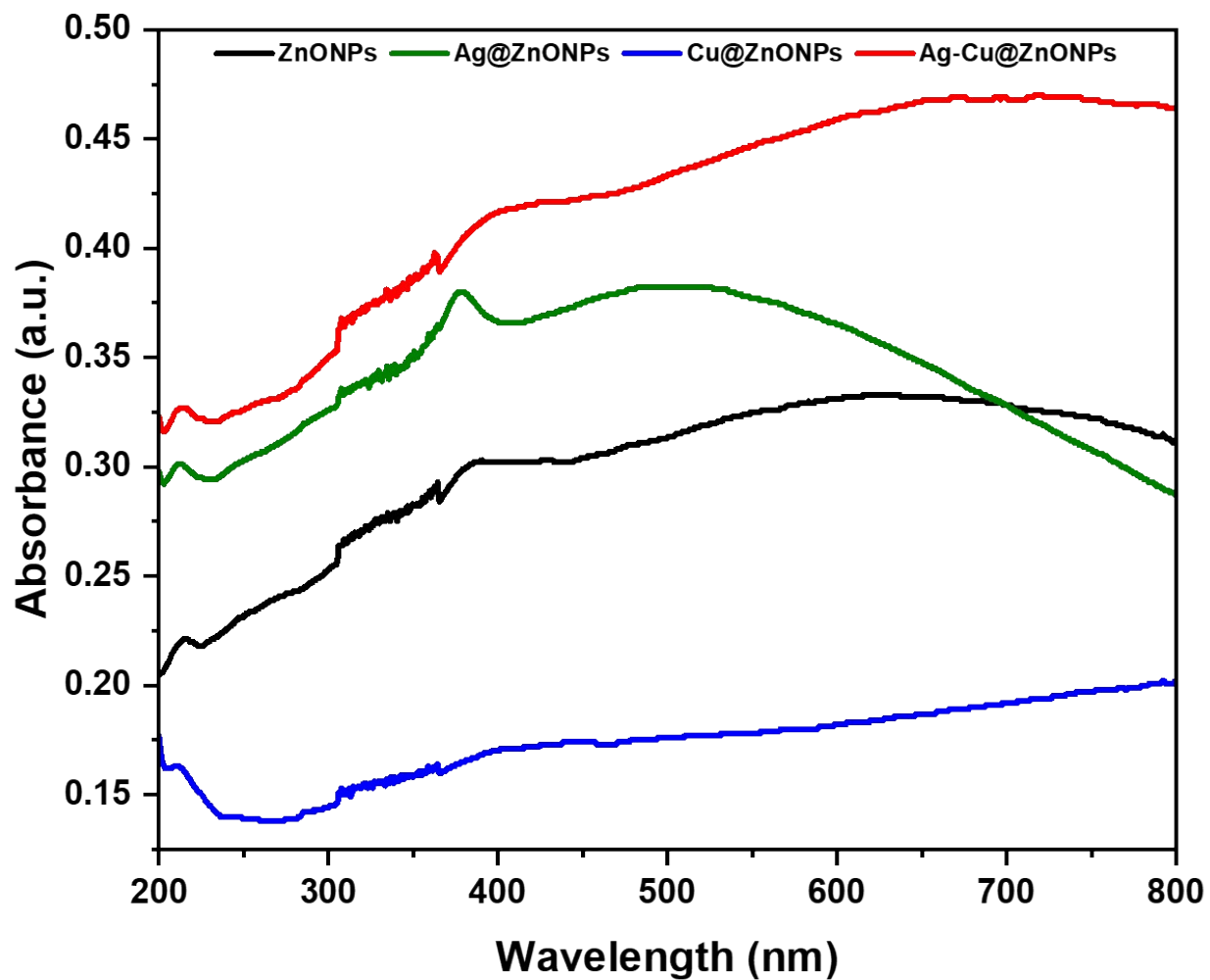


Figure S1. UV-visible spectra of the undoped and doped ZnONPs at a concentration of using 5 mg/50 mL (0.1 mg/mL).

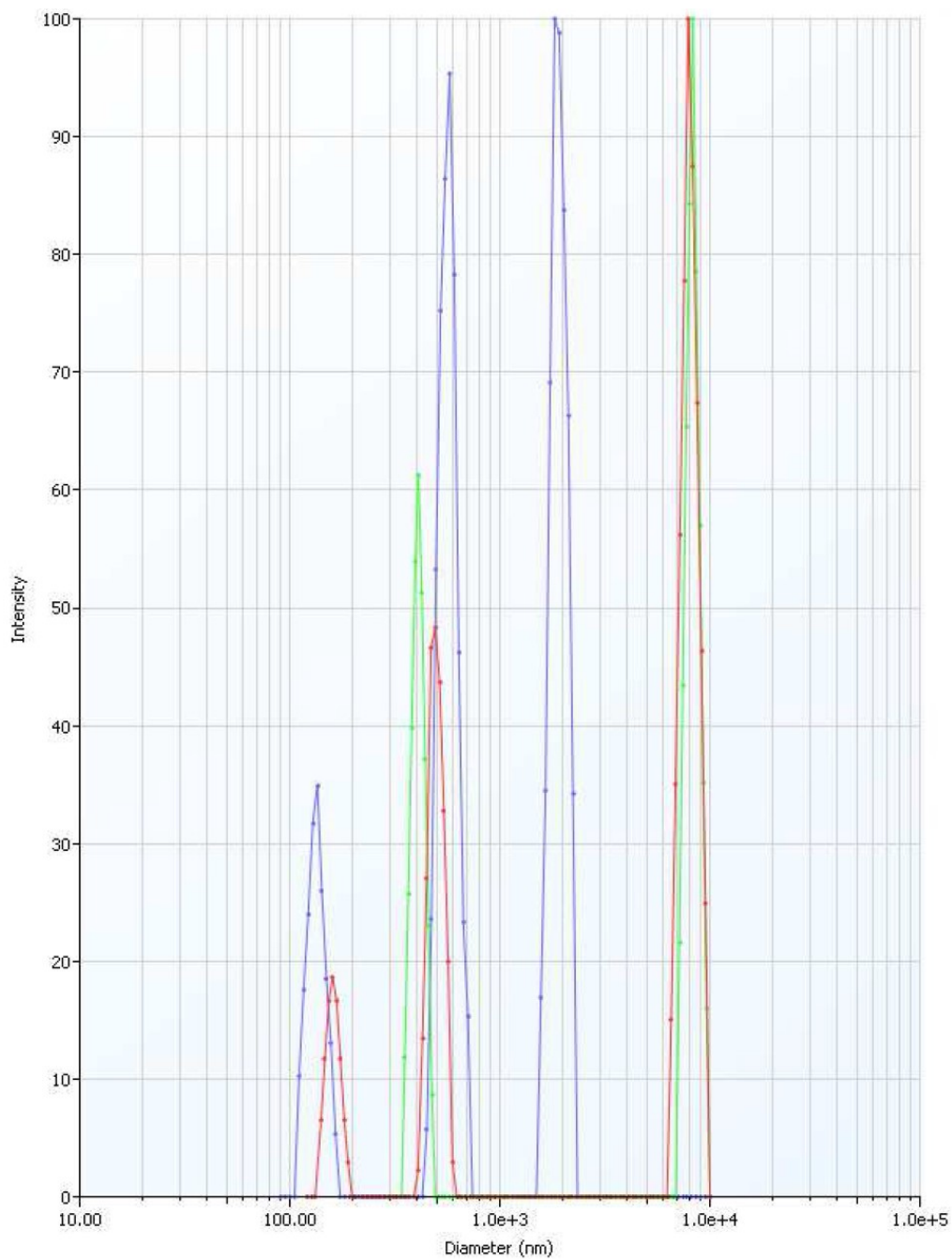


Figure S2. Hydrodynamic size distribution of ZnONPs where red, blue and green color represents readings in triplicates.

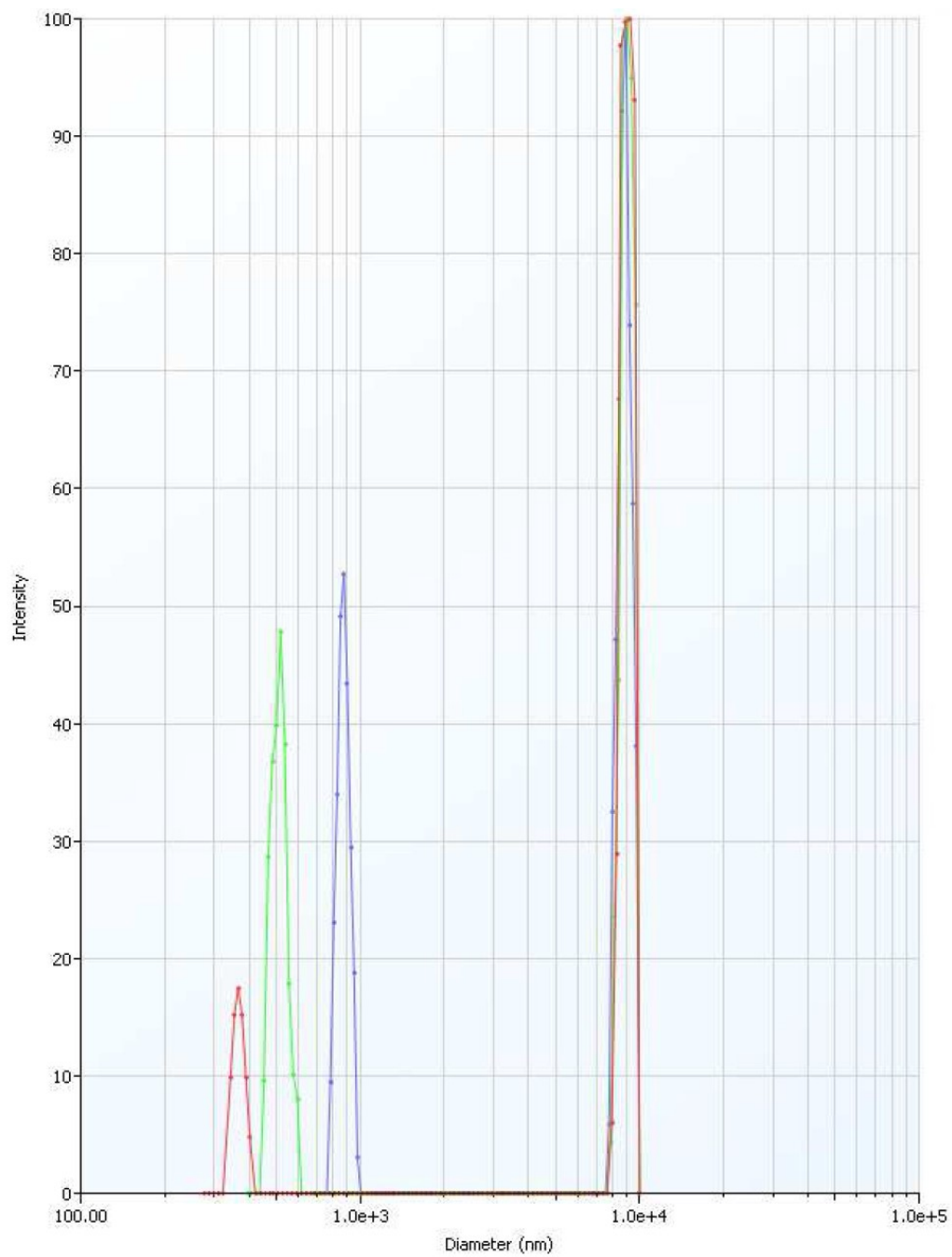


Figure S3. Hydrodynamic size distribution of Ag@ZnONPs where red, blue and green color represents readings in triplicates.

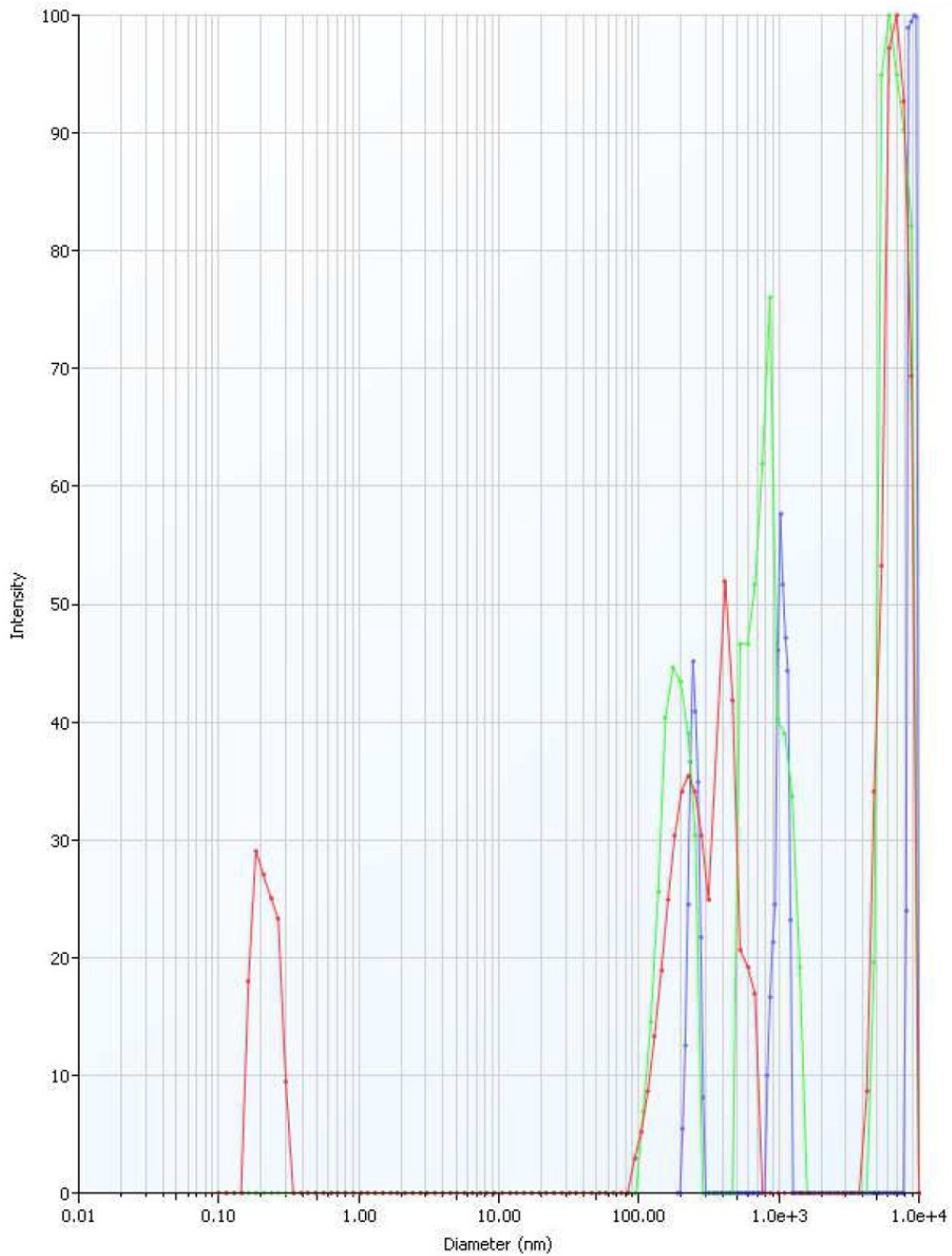


Figure S4. Hydrodynamic size distribution of Cu@ZnONPs where red, blue and green color represents readings in triplicates.

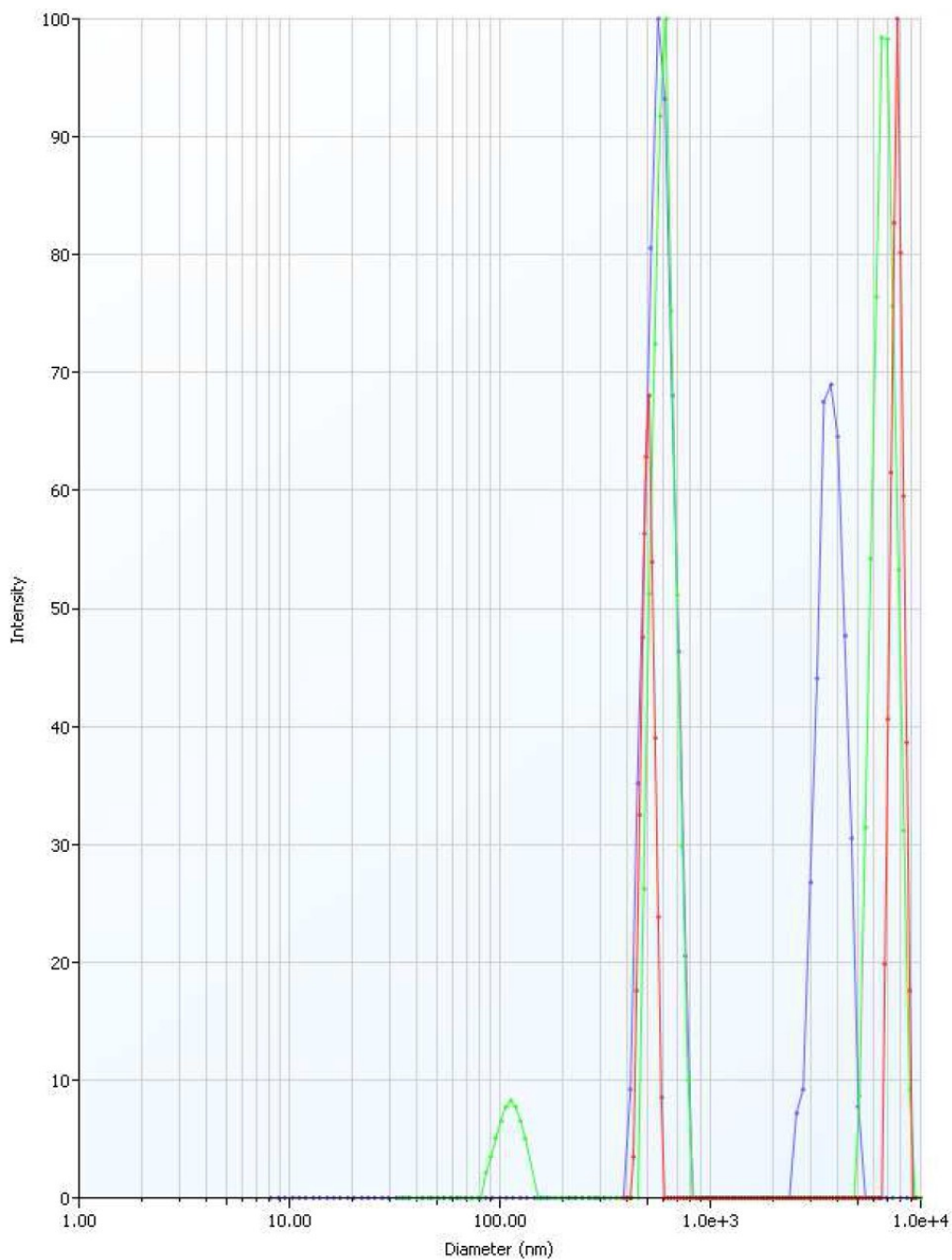


Figure S5. Hydrodynamic size distribution of Ag-Cu@ZnONPs where red, blue and green color represents readings in triplicates.

Type	Start Date/Time	Sample ID	Eff. Diam. (nm)	Polydispersity	Baseline Index	Count Rate (kcps)	Data Retained (%)	Diffusion Coeff. (cm ² /s)
DLS	07-08-2024 14:45:42	M1 - 1	1,824.67	0.376	0.0	56.6	99.32	2.690e-09
DLS	07-08-2024 14:47:43	M1 - 2	1,857.20	0.391	0.0	54.4	98.44	2.642e-09
DLS	07-08-2024 14:49:44	M1 - 3	1,055.87	0.217	0.0	53.3	98.69	4.648e-09
		Mean:	1,579.25	0.328	0.0	54.8	98.82	3.327e-09
		Std Err:	261.86	0.056	0.0	1.0	0.26	6.608e-10
		Std Dev:	453.55	0.096	0.0	1.7	0.45	1.144e-09

Figure S6. DLS summary for size distribution of ZnONPs (n = 3).

Type	Start Date/Time	Sample ID	Eff. Diam. (nm)	Polydispersity	Baseline Index	Count Rate (kcps)	Data Retained (%)	Diffusion Coeff. (cm ² /s)
DLS	08-08-2024 12:15:49	M2 - 1	4,468.45	0.657	0.0	4.1	96.73	1.098e-09
DLS	08-08-2024 12:17:50	M2 - 2	2,534.94	0.448	0.0	4.8	95.84	1.936e-09
DLS	08-08-2024 12:19:51	M2 - 3	2,831.84	0.436	0.0	4.3	94.22	1.733e-09
		Mean:	3,278.41	0.513	0.0	4.4	95.60	1.589e-09
		Std Err:	601.16	0.072	0.0	0.2	0.74	2.523e-10
		Std Dev:	1,041.24	0.124	0.0	0.4	1.28	4.370e-10

Figure S7. DLS summary for size distribution of Ag@ZnONPs (n = 3).

Type	Start Date/Time	Sample ID	Eff. Diam. (nm)	Polydispersity	Baseline Index	Count Rate (kcps)	Data Retained (%)	Diffusion Coeff. (cm ² /s)
DLS	07-08-2024 15:06:52	M3 - 1	1,410.39	0.334	0.0	2.5	94.29	3.480e-09
DLS	07-08-2024 15:08:53	M3 - 2	1,120.76	0.258	0.0	2.4	92.49	4.379e-09
DLS	07-08-2024 15:10:54	M3 - 3	1,505.75	0.298	0.0	2.5	96.00	3.259e-09
		Mean:	1,345.63	0.297	0.0	2.5	94.26	3.706e-09
		Std Err:	115.76	0.022	0.0	0.0	1.01	3.424e-10
		Std Dev:	200.50	0.038	0.0	0.1	1.75	5.931e-10

Figure S8. DLS summary for size distribution of Cu@ZnONPs (n = 3).

Type	Start Date/Time	Sample ID	Eff. Diam. (nm)	Polydispersity	Baseline Index	Count Rate (kcps)	Data Retained (%)	Diffusion Coeff. (cm ² /s)
DLS	07-08-2024 17:17:24	M4 - 1	1,748.43	0.361	0.0	488.4	95.78	2.807e-09
DLS	07-08-2024 17:19:25	M4 - 2	1,272.04	0.301	0.0	472.8	92.61	3.858e-09
DLS	07-08-2024 17:21:26	M4 - 3	995.33	0.252	0.0	470.4	97.44	4.931e-09
		Mean:	1,338.60	0.305	0.0	477.2	95.28	3.865e-09
		Std Err:	219.93	0.031	0.0	5.7	1.41	6.131e-10
		Std Dev:	380.94	0.055	0.0	9.8	2.45	1.062e-09

Figure S9. DLS summary for size distribution of Ag-Cu@ZnONPs (n = 3).

Type	Start Date/Time	Sample ID	Zeta Potential (mV)	Mobility ($\mu\text{s}/(\text{V}/\text{cm})$)	Conductance (μS)	Sample Count Rate (kcps)	Ref. Count Rate (kcps)	RMS Residual
PALS	07-08-2024 14:54:18	M1 - 1	-3.93	-0.31	463	525	830	1.6574e-02
PALS	07-08-2024 14:54:32	M1 - 2	-3.87	-0.30	463	525	830	2.9453e-02
PALS	07-08-2024 14:54:47	M1 - 3	-3.48	-0.27	463	525	830	3.8075e-02
		Mean:	-3.76	-0.29	463	525	830	2.8034e-02
		Std Err:	0.14	0.01	0	0	0	6.2470e-03
		Std Dev:	0.25	0.02	0	0	0	1.0820e-02

Figure S10. Zeta potential summary statistics for ZnONPs (n = 3).

Type	Start Date/Time	Sample ID	Zeta Potential (mV)	Mobility ($\mu\text{s}/(\text{V}/\text{cm})$)	Conductance (μS)	Sample Count Rate (kcps)	Ref. Count Rate (kcps)	RMS Residual
PALS	07-08-2024 15:00:54	M2 - 1	-38.97	-3.05	317	689	1,437	2.1515e-02
PALS	07-08-2024 15:00:58	M2 - 2	-37.47	-2.93	317	689	1,437	2.1276e-02
PALS	07-08-2024 15:01:02	M2 - 3	-38.51	-3.01	317	689	1,437	2.3460e-02
		Mean:	-38.32	-2.99	317	689	1,437	2.2084e-02
		Std Err:	0.45	0.03	0	0	0	6.9160e-04
		Std Dev:	0.77	0.06	0	0	0	1.1979e-03

Figure S11. Zeta potential summary statistics for Ag@ZnONPs (n = 3).

Type	Start Date/Time	Sample ID	Zeta Potential (mV)	Mobility ($\mu\text{s}/(\text{V}/\text{cm})$)	Conductance (μS)	Sample Count Rate (kcps)	Ref. Count Rate (kcps)	RMS Residual
PALS	07-08-2024 15:16:16	M3 - 1	-30.96	-2.42	377	594	826	6.4433e-02
PALS	07-08-2024 15:16:31	M3 - 2	-33.53	-2.62	377	594	826	2.6660e-02
PALS	07-08-2024 15:16:45	M3 - 3	-34.27	-2.68	377	594	826	4.0356e-02
		Mean:	-32.92	-2.57	377	594	826	4.3816e-02
		Std Err:	1.00	0.08	0	0	0	1.1040e-02
		Std Dev:	1.74	0.14	0	0	0	1.9123e-02

Figure S12. Zeta potential summary statistics for Cu@ZnONPs (n = 3).

Type	Start Date/Time	Sample ID	Zeta Potential (mV)	Mobility ($\mu\text{s}/(\text{V}/\text{cm})$)	Conductance (μS)	Sample Count Rate (kcps)	Ref. Count Rate (kcps)	RMS Residual
PALS	07-08-2024 17:25:27	M4 - 1	-29.96	-2.34	394	529	649	2.3765e-02
PALS	07-08-2024 17:25:41	M4 - 2	-26.05	-2.04	394	529	649	2.8702e-02
PALS	07-08-2024 17:25:55	M4 - 3	-22.97	-1.80	394	529	649	6.1550e-02
		Mean:	-26.33	-2.06	394	529	649	3.8006e-02
		Std Err:	2.02	0.16	0	0	0	1.1858e-02
		Std Dev:	3.50	0.27	0	0	0	2.0539e-02

Figure S13. Zeta potential summary statistics for Ag-Cu@ZnONPs (n = 3).