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Revitalizing digenite $Cu_{1.8}S$ nanoparticles with localized surface plasmon resonance (LSPR) effect by manganese incorporation

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ELECTRONIC SUPPLEMENTARY INFORMATION

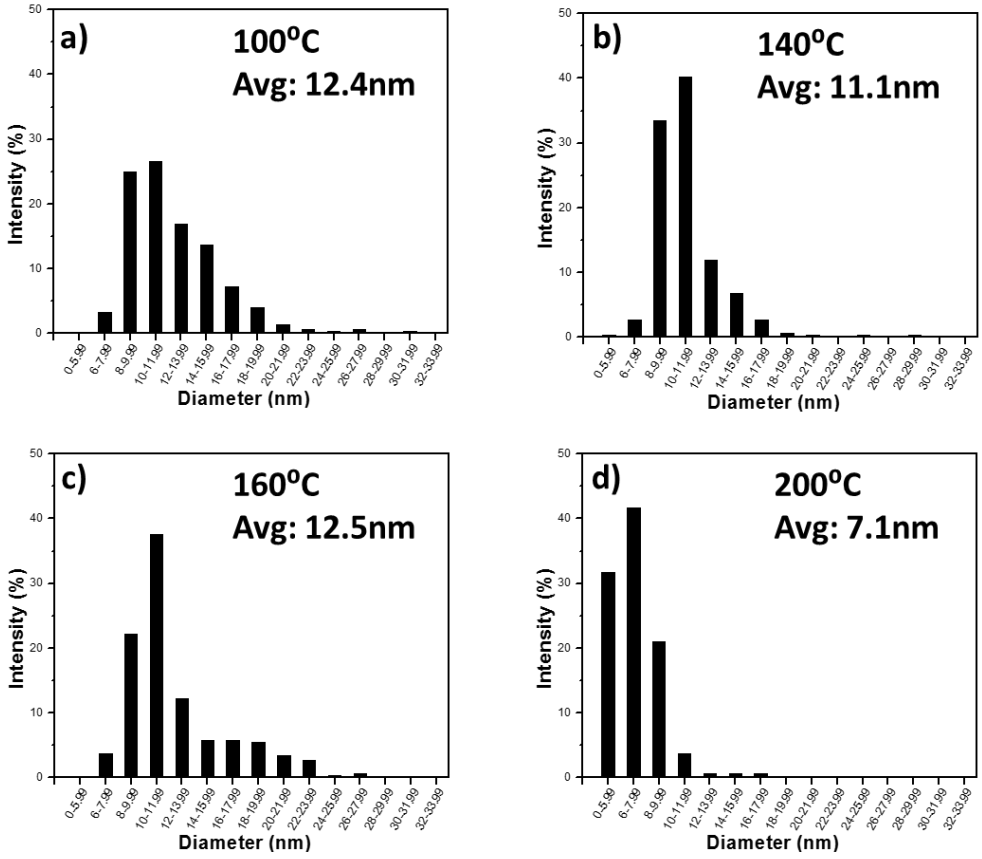

Fig. S1 Particle size distributions of $Cu_{2-x}S$ nanoparticles synthesized at various temperatures.

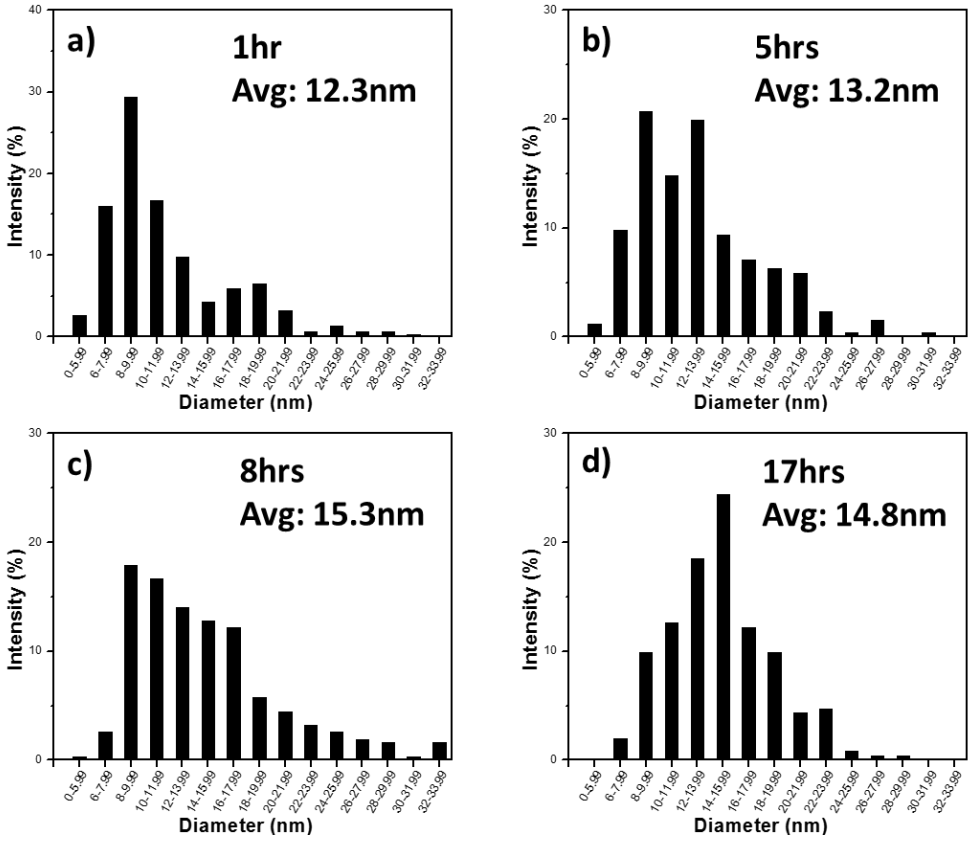

Fig. S2 Particle size distributions of $Cu_{2-x}S$ nanoparticles synthesized with various reaction time.

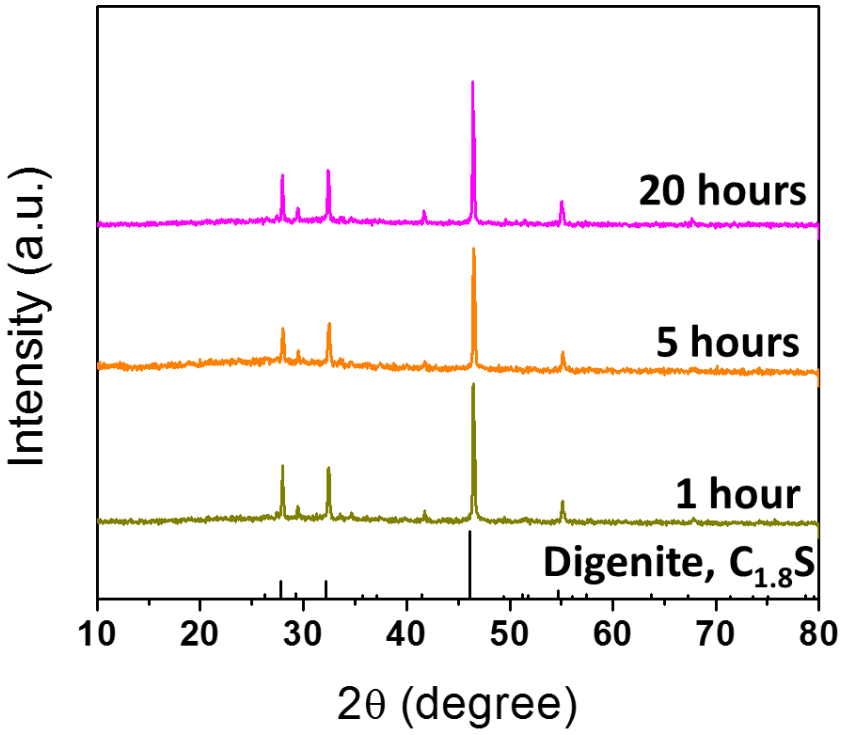

Fig. S3 XRD patterns of digenite $Cu_{1.8}S$ nanoparticles after 1 hour, 5 hours, and 20 hours of reaction at 140°C.

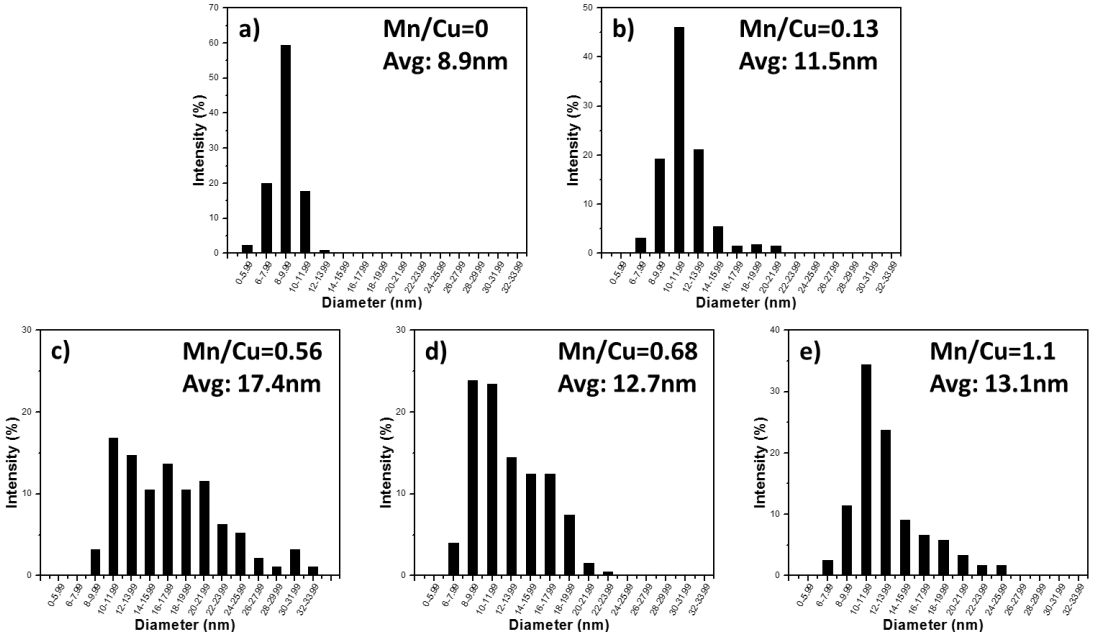

Fig. S4 Particle size distributions of Cu_xMn_yS nanoparticles with various Mn contents.

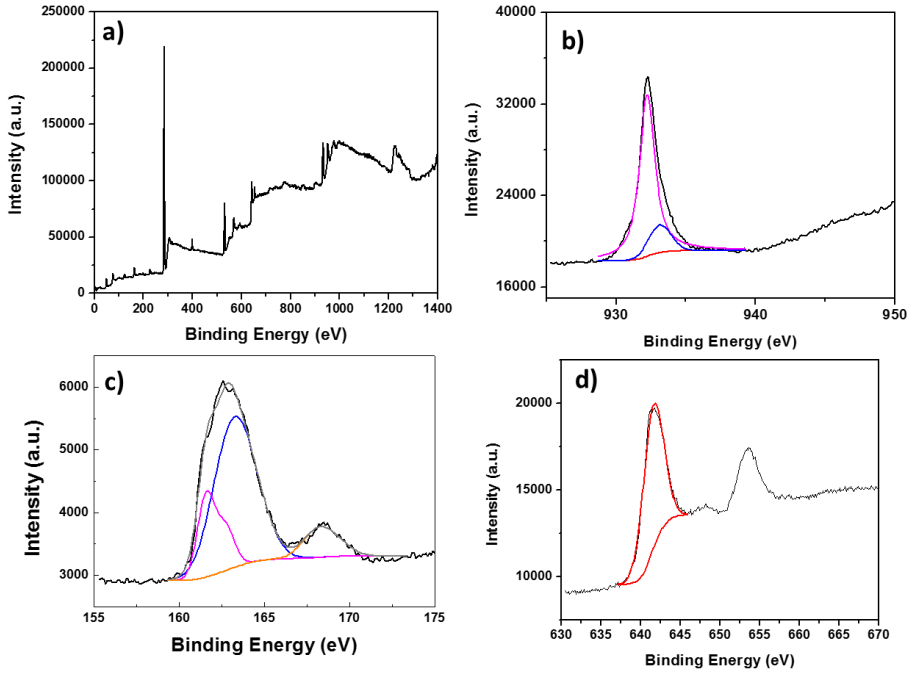

Fig. S5. XPS spectra for the Mn_xCu_yS nanparticles: (a) XPS survey spectrum of Mn_xCu_yS nanparticles. (b) core level spectrum for Cu 2p. (c)) core level spectrum for S 2p. (d)) core level spectrum for Mn 2p.

Table S1 Summary of the Vis-NIR absorption spectra of the $Cu_{2-x}S$ nanoparticles synthesized at 140°C, 160°C, and 200°C.

Reaction temperature	Peak position	FWHM	Peak height	Peak area	LSPR absorbance?
140°C	1215nm	560	0.93	552	√
160°C	1219nm	492	0.87	455	√
200°C	-	-	-	-	weak

Table S2 Summary of the Vis-NIR absorption spectra of the $Cu_{2-x}S$ nanoparticles synthesized with different reaction time.

Reaction time	Peak position	FWHM	Peak height	Peak area	LSPR absorbance?
1 hour	1232nm	535	1.30	840	√
5 hours	1276nm	800	1.01	760	√
8 hours	1276nm	670	0.67	578	√
17 hours	-	-	-	-	weak

Table S3 Summary of the Vis-NIR absorption spectra of the Cu_xMn_yS nanoparticles with different Mn contents.

Mn/Cu	Peak position	FWHM	Peak height	Peak area	LSPR absorbance?
1.1	1070nm	650	1.27	872	√
0.68	1084nm	693	1.05	780	√
0.56	1092nm	704	0.85	625	√
0.13	-	-	-	-	weak
0	-	-	-	-	weak