Electronic Supporting Information

Sintering mechanism of the Cu-Ag core-shell nanoparticle paste at low temperature in ambient air

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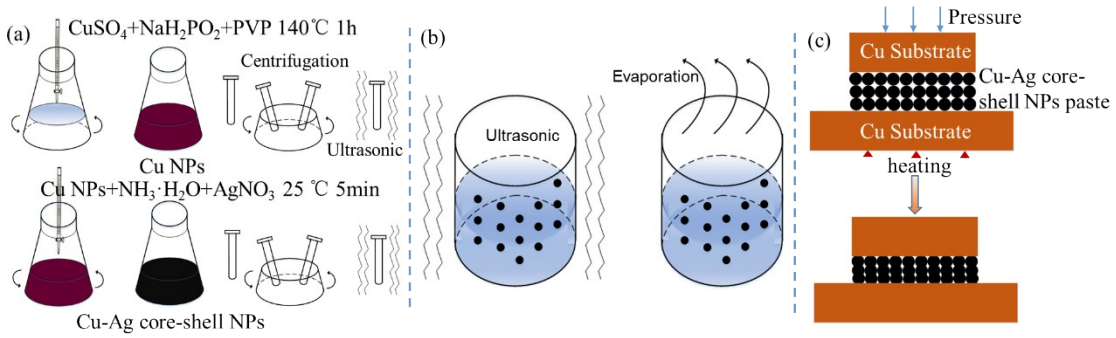

Figure S1 Schematic diagram of fabrication steps: (a) synthesis of Cu-Ag core-shell NPs using a two-step method (b) preparation of NPs paste (c) bonding Cu substrates using Cu-Ag core-shell NPs paste at low temperature.

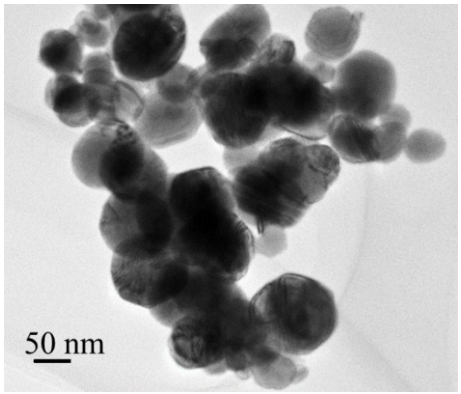

Figure S2 TEM image of initial Cu NPs

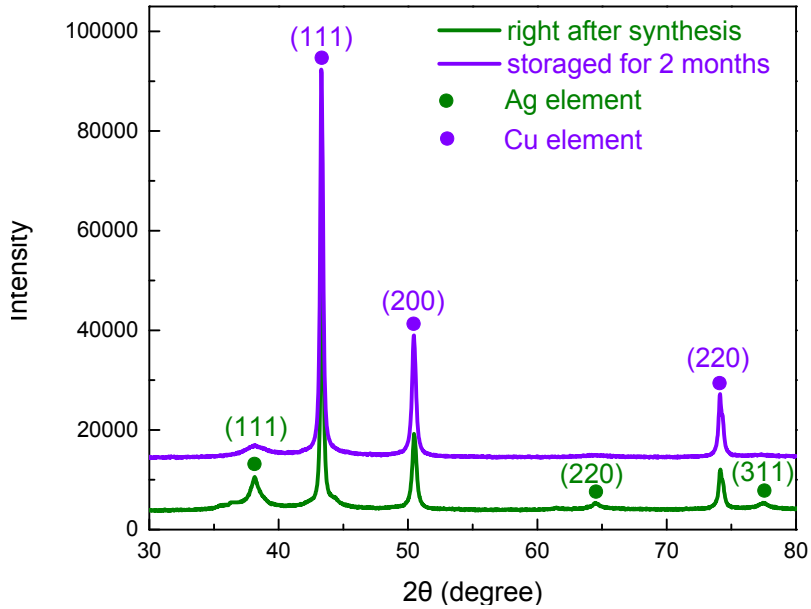

Figure S3 XRD pattern comparison of Cu-Ag core-shell NPs before and after having been stored in ethanol for 2 months.

Table 1 Quantitatively calculated composition of Cu, O, and Ag elements in bimetallic Cu-Ag NPs after having been stored for 2 months based on the Gaussian curve-fitted area.

Cu2p [at%]		O1s [at%]		Ag3d [at%]
Cu02p	Cu2+2p	O01s	O-2s	Ag3d
68.84	2.5	3.19	3.03	22.44

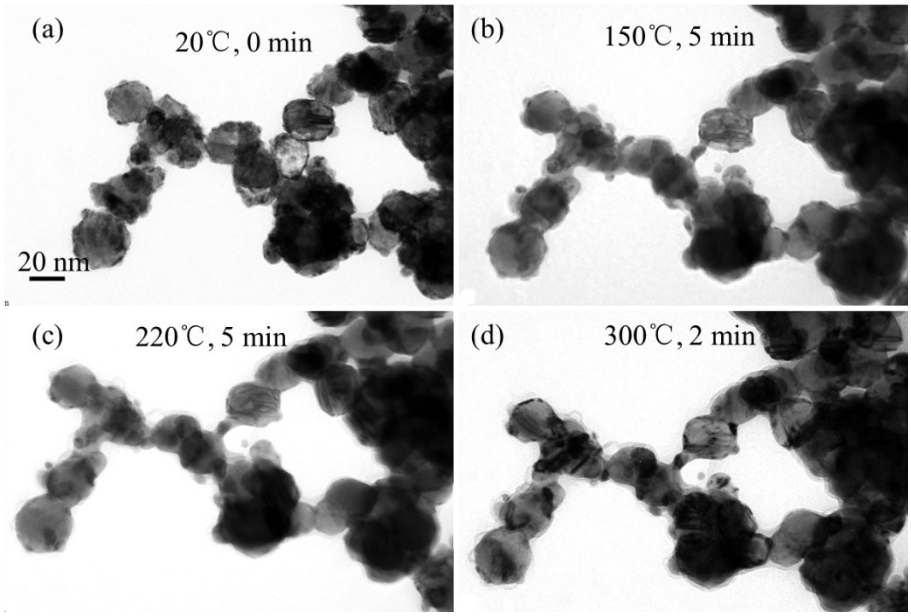

Figure S4 Joining process of Cu-Ag core-shell NPs during in situ TEM heating: (a) initial Cu-Ag core-shell NPs (b) after having been heated at 150 ℃ for 5 min (c) after having been heated at 220 ℃ for 5 min (d) after having been heated at 300 ℃ for 5 min.

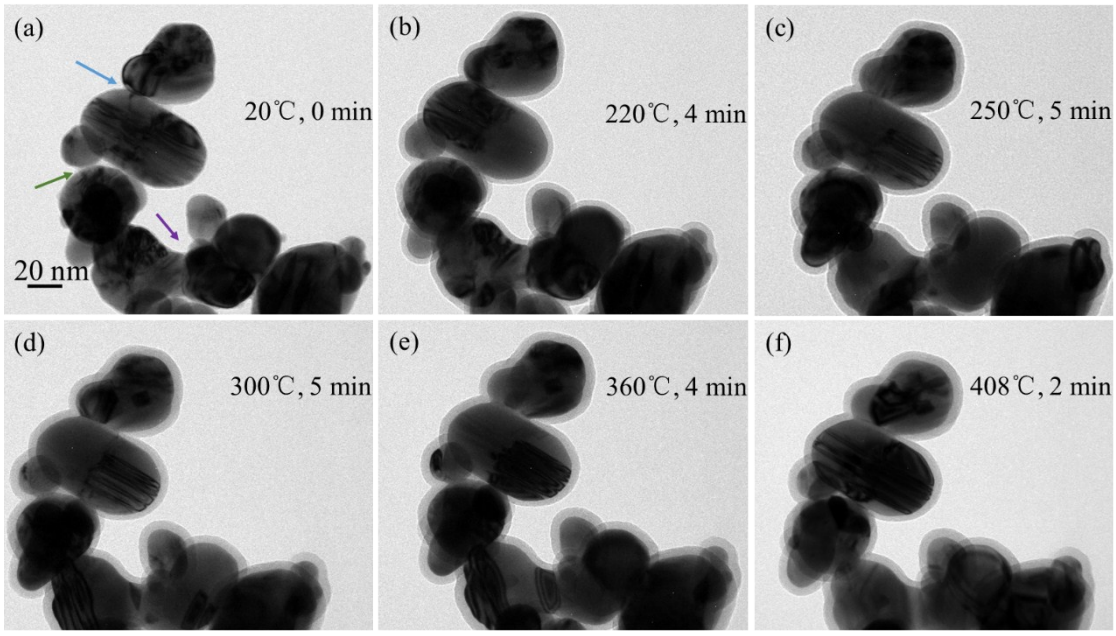

Figure S5 Joining process of Cu NPs during in situ TEM heating: (a) initial Cu NPs (b) after having been heated at 220℃ for 4 min (c) after having been heated at 250℃ for 5 min (d) after

having been heated at 300℃ for 5 min (e) after having been heated at 360℃ for 5 min (f) after having been heated at 408℃ for 2 min.

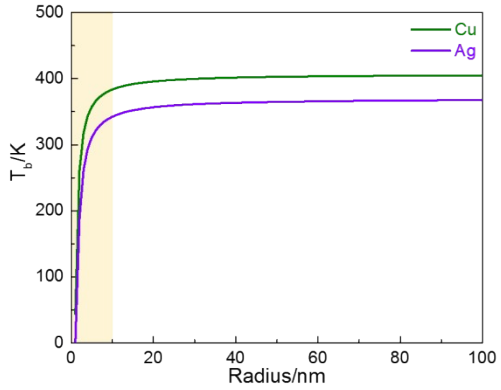

Figure S6 Numerical simulation of sintering beginning temperature of Cu and Ag NPs with different diameter.

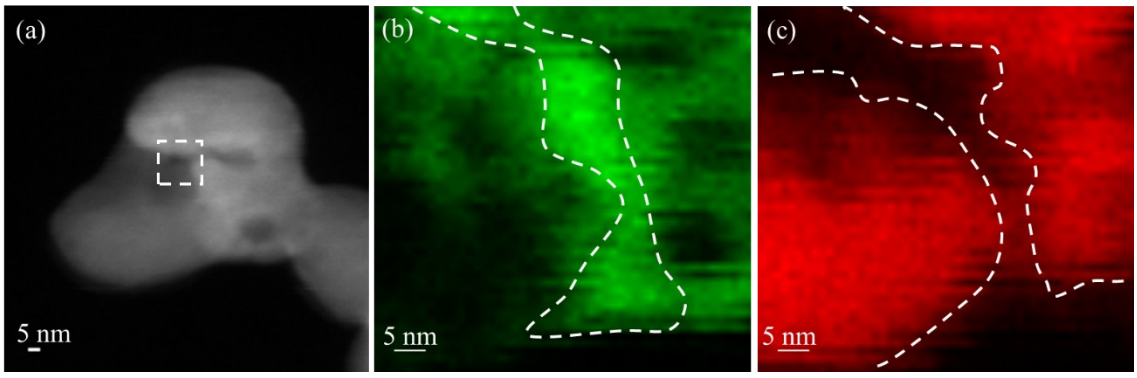

Figure S7 TEM-EDX analysis of sintered Cu-Ag core-shell NPs: (a) original TEM image (b) Ag component (c) Cu component.

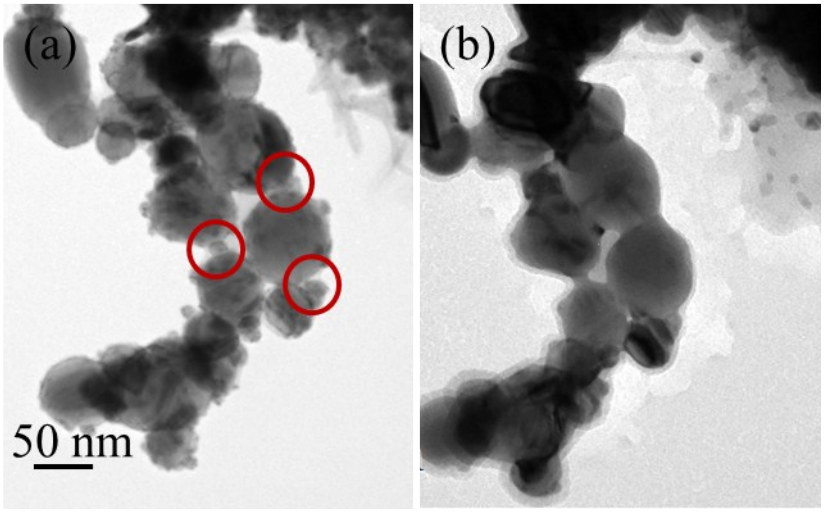

Figure S8 TEM images of (a) initial Cu-Ag core-shell NPs before heating and (b) Cu-Ag core-shell NPs after heated at 180℃ for 5 min.