**Electronic Supplementary Information**

# Facile fabrication and low temperature bonding of Cu@Sn-Bi core-shell particles for conductive paste

Zhehan Yang, Yi Pan, Hengyu Zhao, Xiangmin Yang, Ying Liang, Zhen Zhang* and Bin Fang*

Institute of Nuclear Technology and Application, School of Science, East China University of Science and Technology, Shanghai 200237, P. R. China.

E-mail: zhangzhen@ecust.edu.cn; binfang@ecust.edu.cn

**Table S1** The experimental conditions of Cu@Sn-Bi particles

| Sample | The mass ratio of Sn to Bi | The mass ratio of Cu to Sn-Bi | Stirring speed |
|---|---|---|---|
| 1 | 48:52 (Self-made, 3-10 nm) | 1:5 | 300 rpm |
| 2 | 48:52 (Self-made, 3-10 nm) | 2:5 | 300 rpm |
| 3 | 48:52 (Self-made, 3-10 nm) | 4:5 | 90 rpm |
| 4 | 48:52 (Self-made, 3-10 nm) | 4:5 | 180 rpm |
| 5 | 48:52 (Self-made, 3-10 nm) | 4:5 | 240 rpm |
| 6 | 48:52 (Self-made, 3-10 nm) | 4:5 | 300 rpm |
| 7 | 42:58 (purchased, 10-25 μm) | 4:5 | 300 rpm |
| 8 | 48:52 (Self-made, 3-10 nm) | 6:5 | 300 rpm |

Ripening condition: 160 ℃, 30 min and 180 ℃, 10 min.

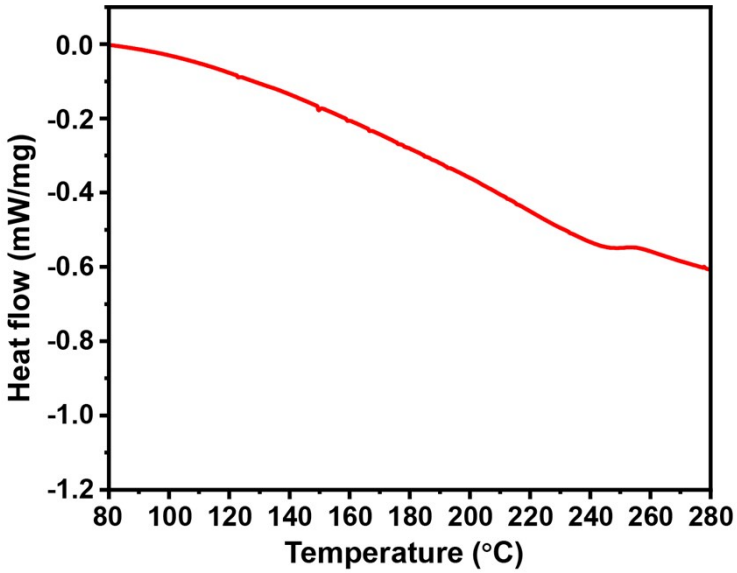


**Fig. S1** DSC result of Sn and Bi NPs mixtures.

**Fig. S2** Digital photograph of as-synthesized Cu@Sn-Bi at the stirring speed of 90 rpm (Sample 3).

**Fig. S3** Digital photograph of as-synthesized Cu@Sn-Bi using the purchased Sn-Bi alloy particles ($10 \leq d \leq 25$ μm) as the precursor (Sample 7).

**Table S2** The volume resistivity of printed circuits using different Cu@Sn-Bi paste solidified at different temperature

| Volume resistivity (μΩ·cm) / Solidifying temperature (℃) / Fillers | 160 ℃ | 180 ℃ | 200 ℃ | 220 ℃ | 240 ℃ |
|---|---|---|---|---|---|
| Cu@Sn-Bi-0.2 | over testing range | $1.03\times10^{7}$ | $6.52\times10^{6}$ | $8.76\times10^{6}$ | over testing range |
| Cu@Sn-Bi-0.4 | $2.98\times10^{7}$ | 76300 | 73400 | 85600 | $6.46\times10^{6}$ |
| Cu@Sn-Bi-0.8 | $2.34\times10^{8}$ | 550 | 481 | 556 | $1.80\times10^{7}$ |
| Cu@Sn-Bi-1.2 | over testing range | | | | |

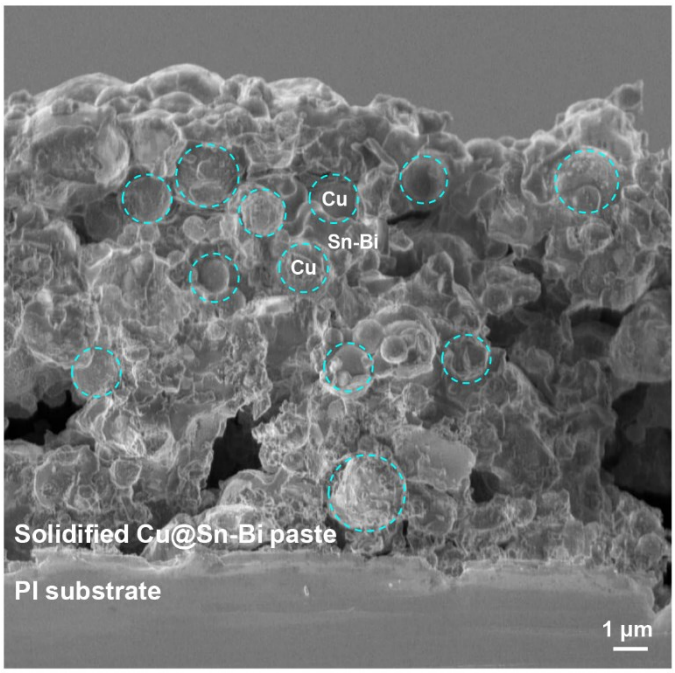


**Fig. S4** The cross section SEM image of printed circuit (Cu@Sn-Bi-0.8) solidified at 180℃. The SEM image taken with 3.0 kV accelerating voltage.

**Table S3** The volume resistivity of Cu based conductive inks

| Ref | Filler | Size | Content (%) | Curing temperature (℃) | Volume resistivity (μΩ·cm) |
|---|---|---|---|---|---|
| 1 | Cu | 45 ± 5 nm | 100 | 400 | $3.32\times10^{10}$ |
| 2 | Cu and $Cu_2O$ | < 10 nm | 67 | 300 | 480 |
| 3 | Cu@Ag | 11.7 nm | 70 | chemical sintering | 300 |
| 4 | Cu | 20-110 nm | 100 | 200 | 1100 |
| | | | | 300 | 86 |
| 5 | Cu | 10-20 nm | 100 | 200 | 730 |
| 6 | Cu | 37 nm | 100 | 200 | 62 |
| This work | Cu@Sn-Bi | 1.82 μm | 59 | 200 | 481 |

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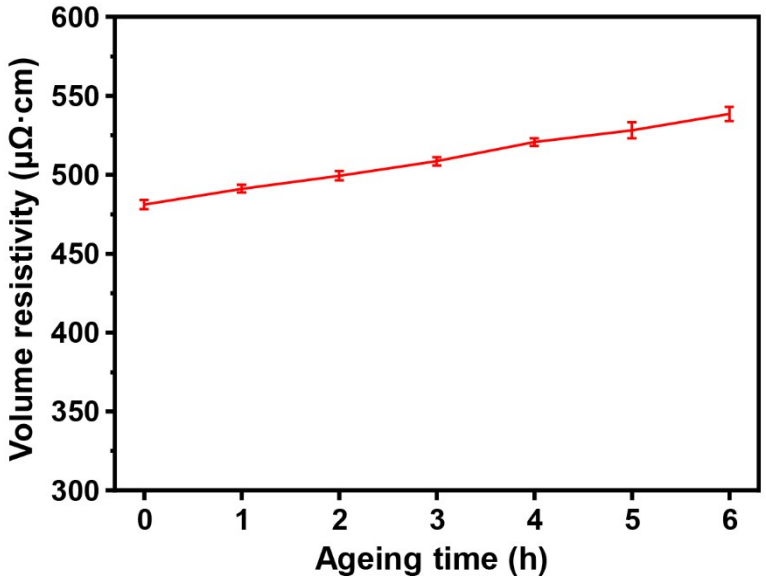


**Fig. S5** The variation of volume resistivity after ageing for 6 h at 190℃.
(Cu@Sn-Bi-0.8 paste sintered at 200 ℃)

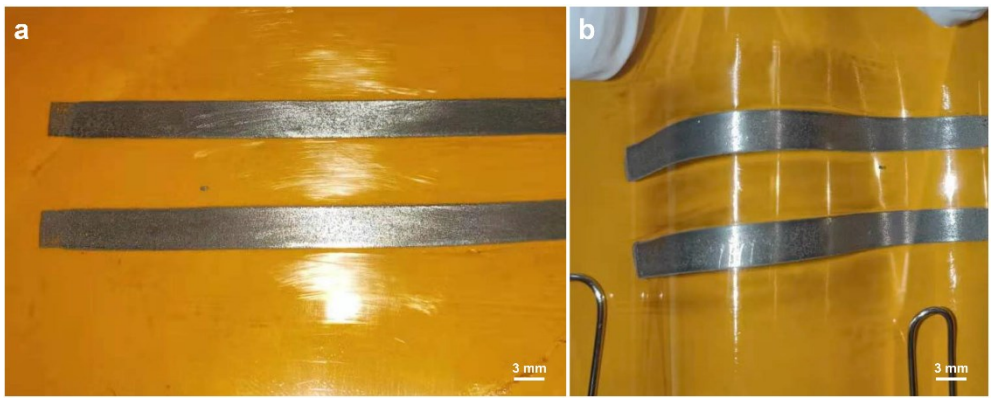


**Fig. S6** (a) The digital photograph of circuits on the PI film using Cu@Sn-Bi-0.8 paste solidified at 200℃; (b) the corresponding circuits after 100 cycles of repetitive strain around the cylinder.