**Supporting information**

# High reliable and high conductive submicron Cu particle patterns fabricated by low temperature heat-welding and subsequent flash light sinter-reinforcement

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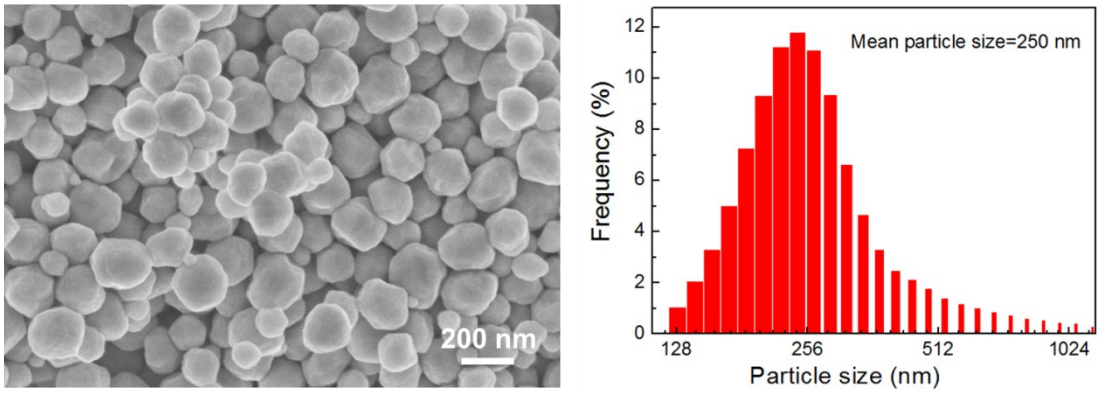


Fig. S1 SEM micrographs of received copper particles and the corresponding particle size distribution.

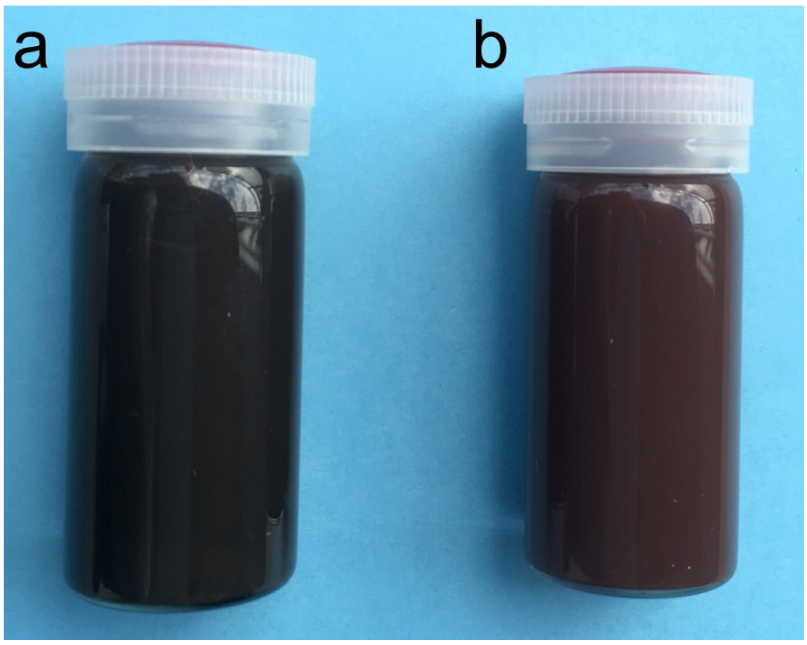


Fig. S2 (a) Submicron Cu particle ink with Cuf-AMP complex and (b) Submicron Cu particle ink without Cuf-AMP complex.

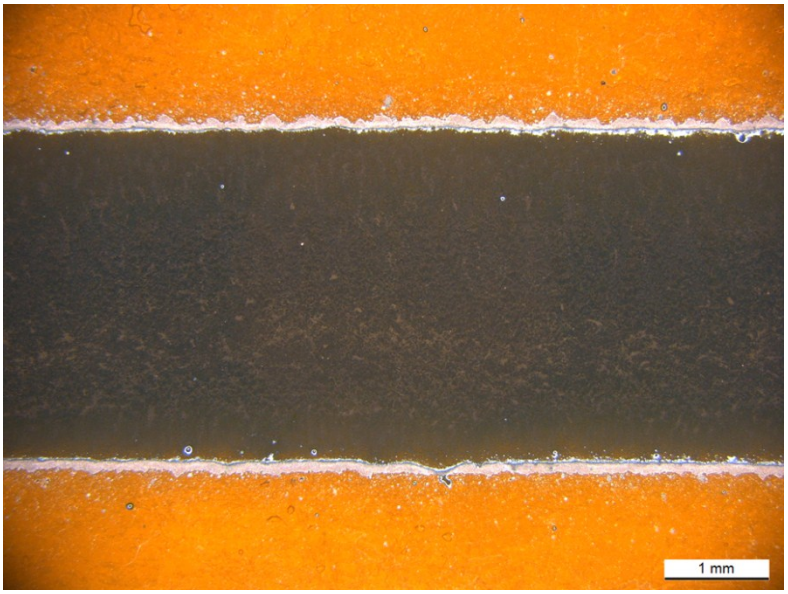


Fig. S3 Printed Cu pattern after flash light sintering using the energy of 2073 mJ/cm$^2$. The color of the printed Cu pattern is kept deep blue.

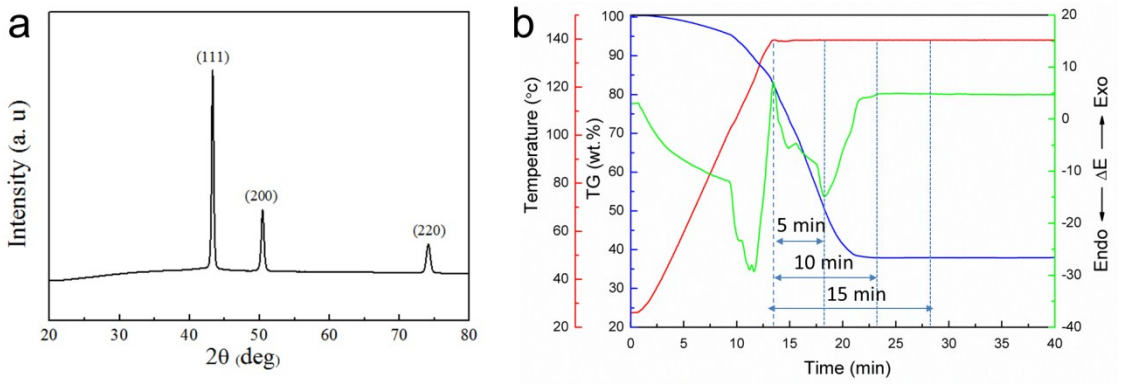


Fig. S4 (a) XRD pattern of Cuf-AMP complex after heat treatment at 140 °C for 15 min under nitrogen atmosphere and (b) TG-DTA plots of submicron Cu particle ink under a nitrogen atmosphere. Testing condition is that the temperature was heated to 140 °C and then kept on 140 °C for 30 min.

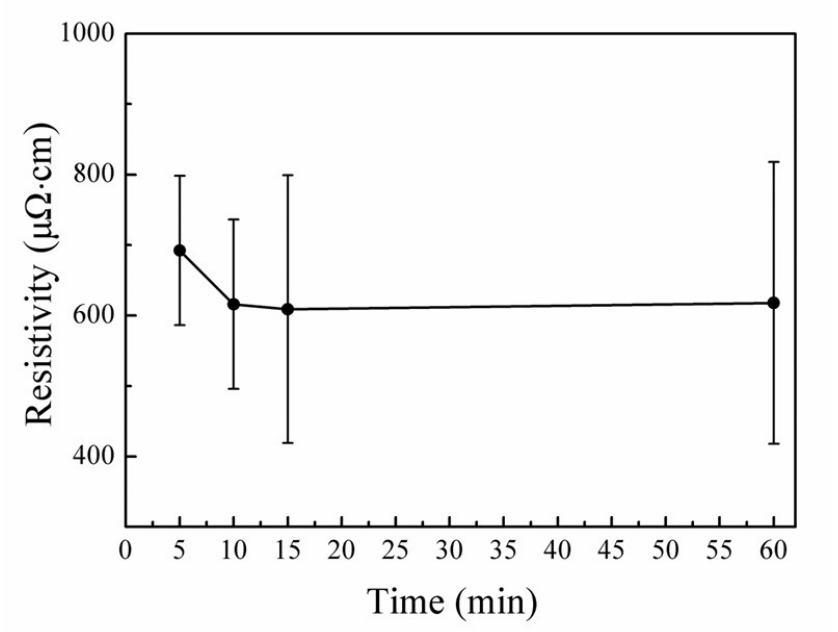


Fig. S5 Resistivity of sintered Cu patterns depending on the holding time at 140 °C under a nitrogen atmosphere.

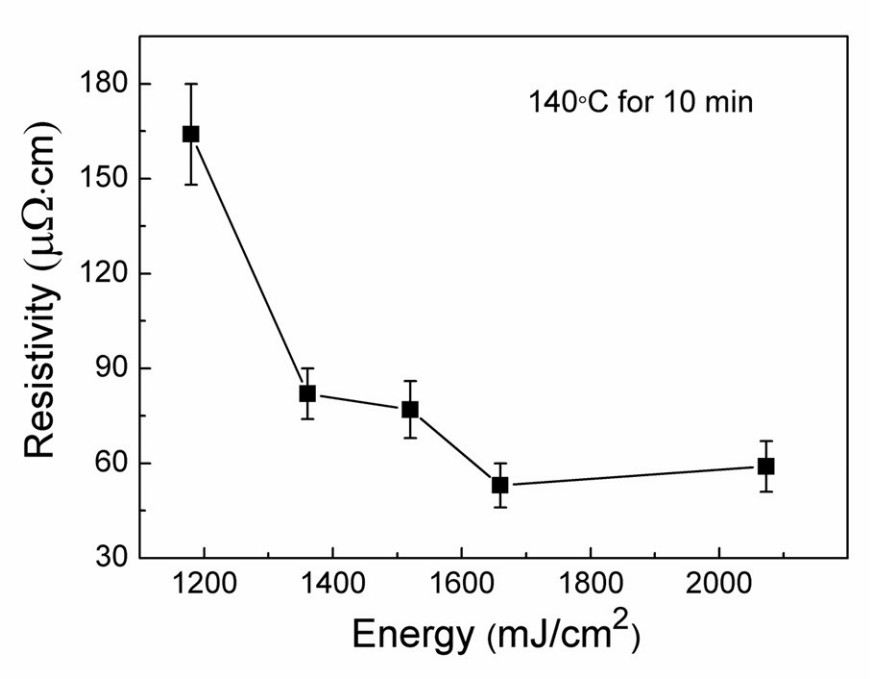


Fig. S6 Resistivity evolution of sintered Cu patterns prepared from Cu ink without Cuf-AMP complex as function of supply flash light energy.

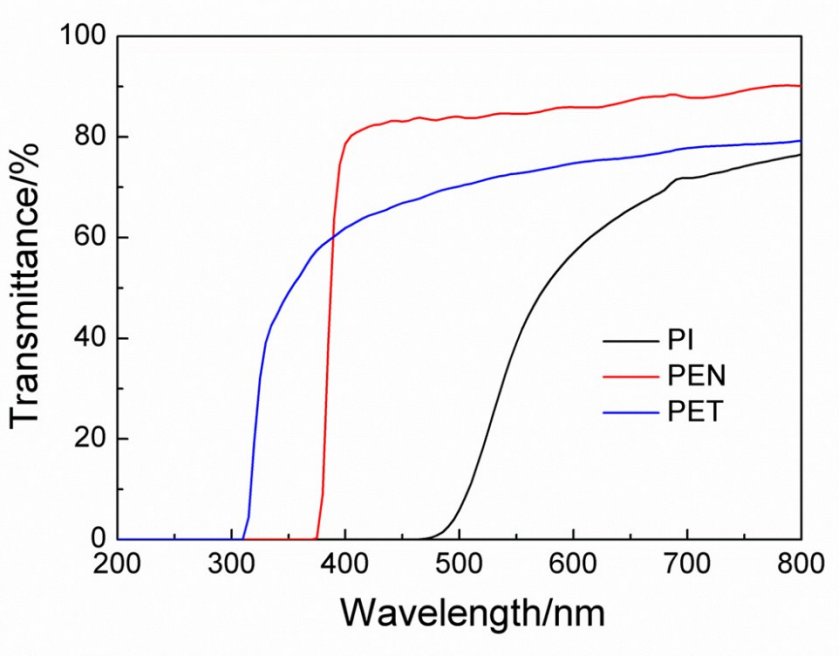


Fig. S7 Transmittance spectra of PI, PEN and PET substrates.

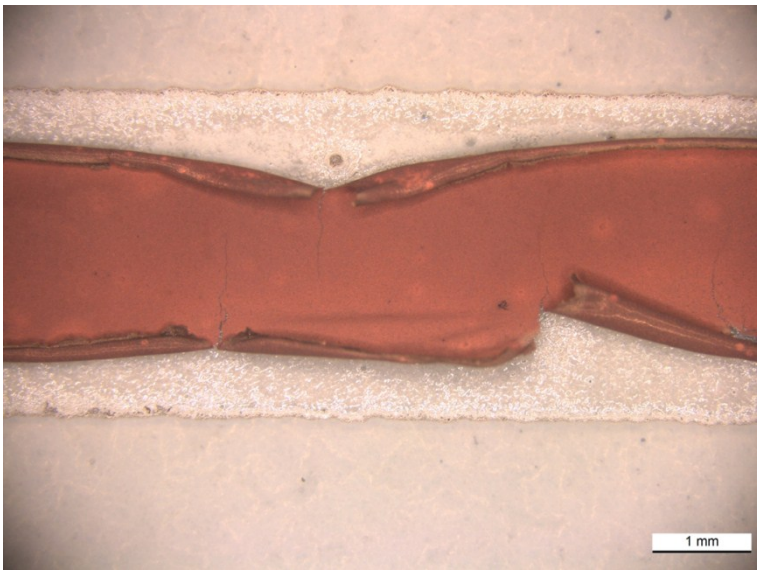


Fig. S8 Sintered Cu pattern peeled off from the substrate due to photo-chemical damage to the underlying substrate.

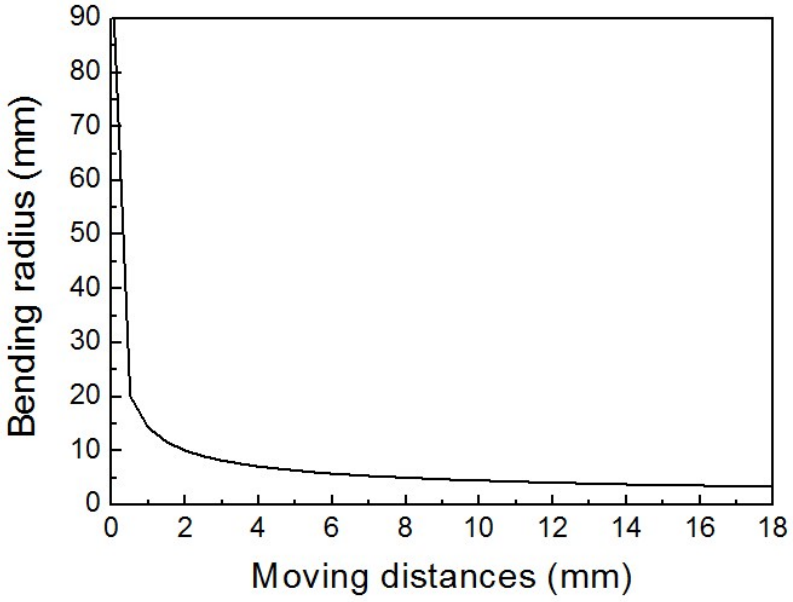


Fig. S9 Relationship between bending radius and moving distance.

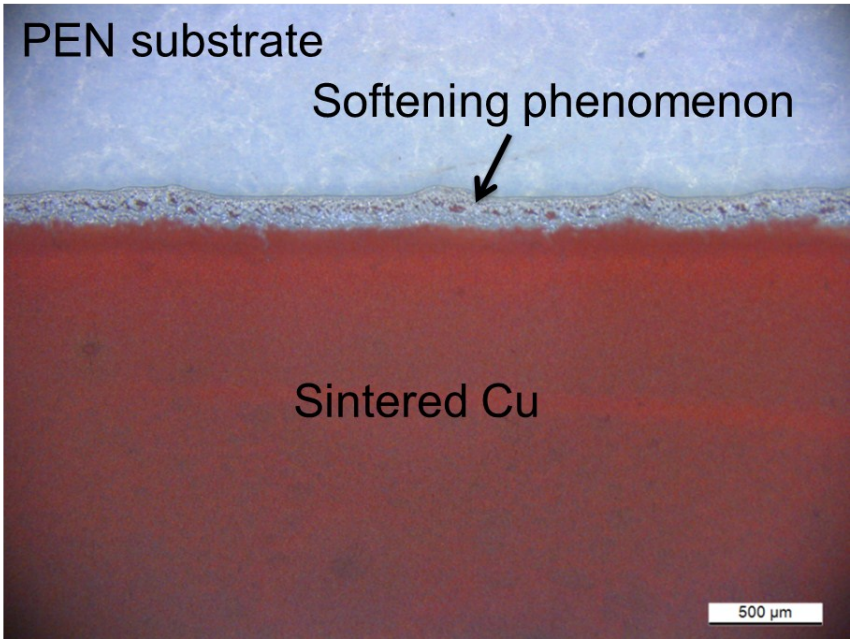


Fig. S10 Softening phenomenon of sintered Cu pattern on PEN substrate.

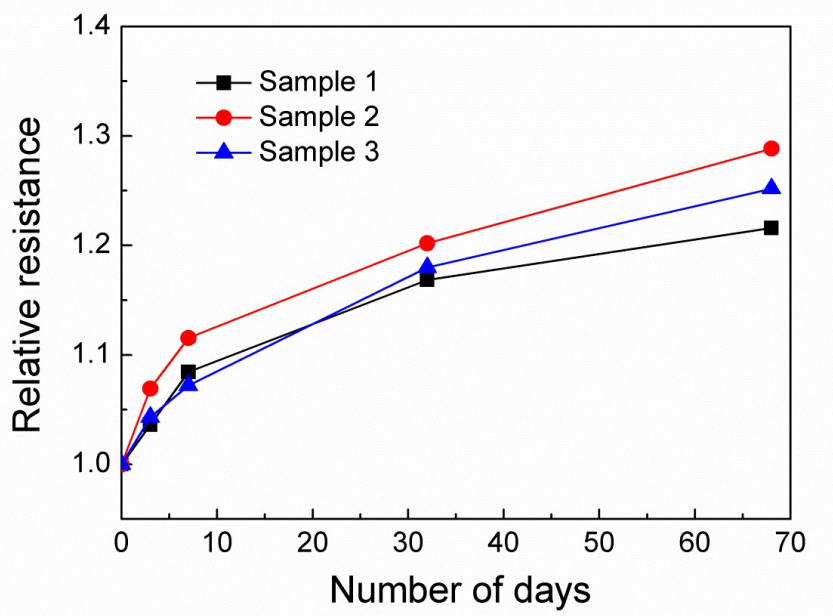


Fig. S11 Relative resistance of sintered Cu patterns on PEN substrate over the duration of 68 days in ambient atmosphere. All the samples were prepared from low temperature welding of 140 $^{o}$C for 10 min with flash light sinter-reinforcement using energy of 1273 mJ/cm$^2$. The temperature and relative humidity in the oxidation resistance experiment is about 25±3 $^{o}$C and 30~40 %, respectively.

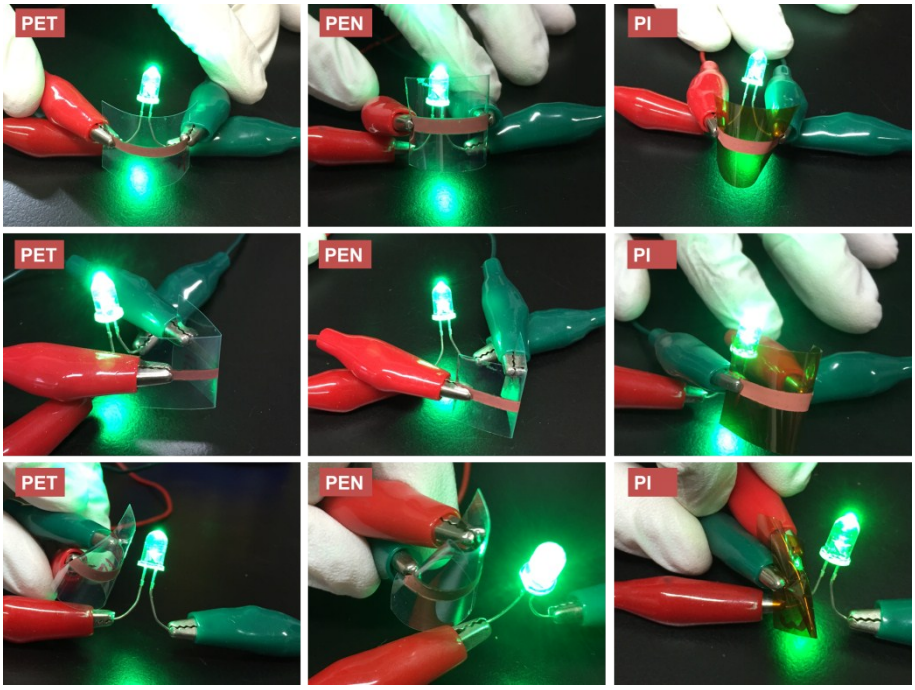


Fig. S12 Photographs of the LED circuit with a 20 mm-long printed conductive pattern on PET, PEN and PI substrates during the bending, folding and twisting tests.