Electronic Supplementary Material (ESI) for Chemical Communications

Injection synthesis of Ni-Cu@Au-Cu nanowires with tunable magnetic and plasmonic properties

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Characterization

XRD patterns of the as-synthesized samples were recorded using a Panalytical X'pert PRO X-ray diffractometer with Cu K_α radiation. Transmission electron microscopy (TEM) images, energy dispersive X-ray spectroscopy (EDS) data, and electron diffraction data were collected on a JEM-2100 transmission electron microscope operating at 200 kV. High-resolution TEM (HRTEM) and high-angle annular dark-field (HAADF) images were recorded on a TECNAI F-30 transmission electron microscope operating at 300 kV. Scanning electron microscopy (SEM) was performed on a LEO-1530 scanning electron microscope. UV-visible-Near Infrared (NIR) spectroscopic data were obtained on a Shimadzu UV-2550 ultraviolet visible spectrophotometer. Magnetic measurements were performed using a physical property measurement system (PPMS-9, Quantum Design) in a temperature range of 5-350 K. The samples for magnetic measurements are in the form of powders. The nanowires (see Fig. 1(a) and Fig. S8 (a)) can be considered as a random distribution without a specific orientation.

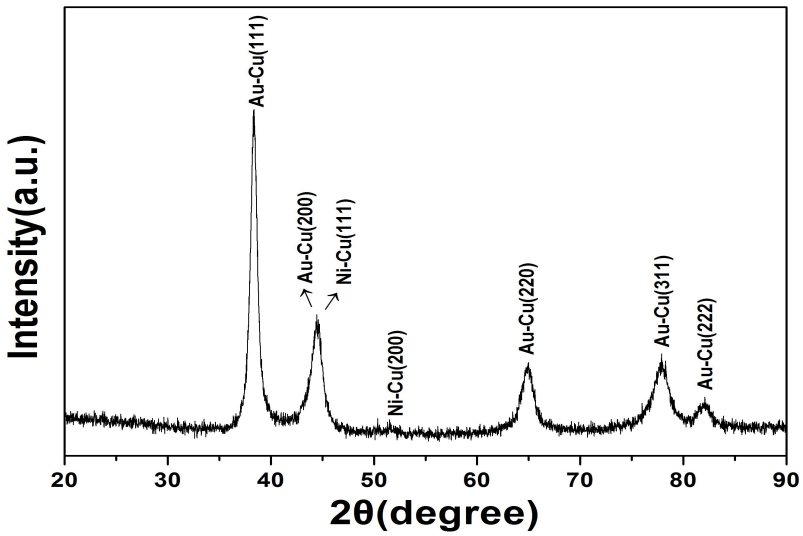


Fig. S1 XRD pattern of the as-prepared Ni-Cu@Au-Cu nanowires.

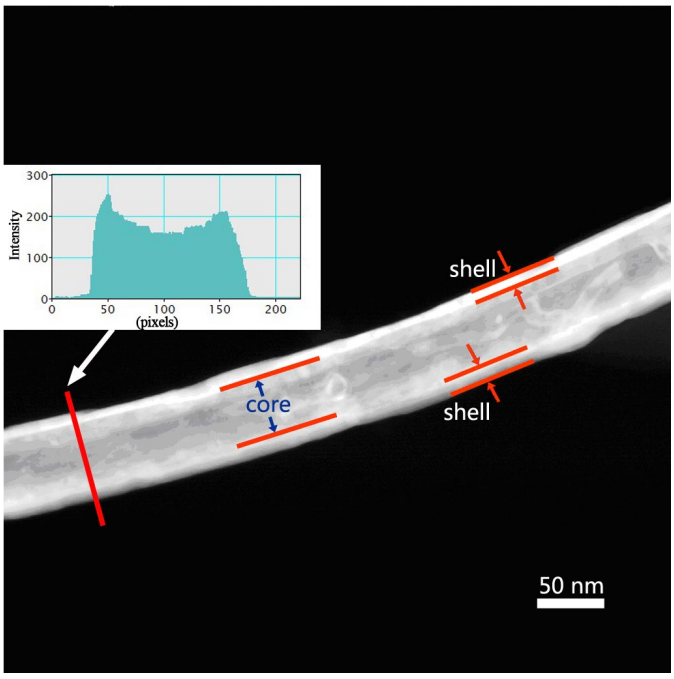


Fig. S2 The HAADF image of a Ni-Cu@Au-Cu nanowire. The inset shows the image intensity profile across the diameter (arrowed red line). The edge obviously shows a higher intensity (brighter in the image), revealing a core-shell structure.

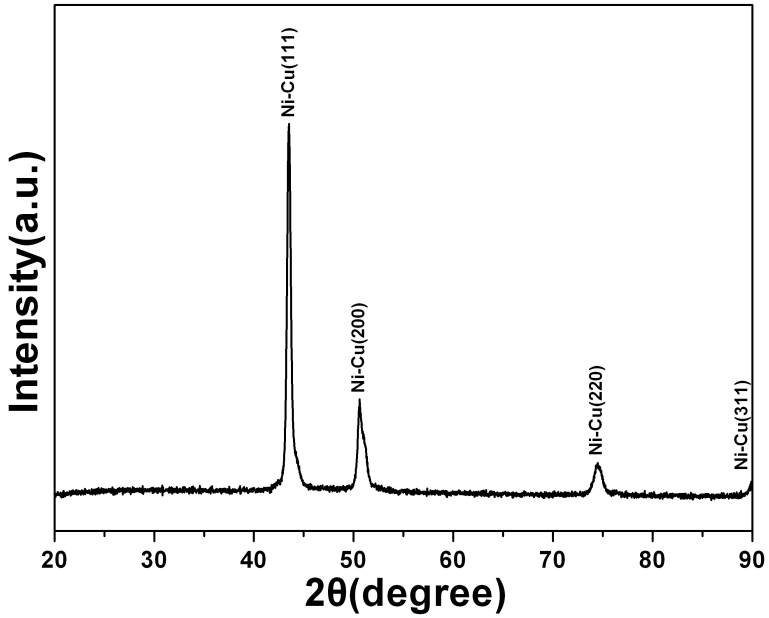


Fig. S3 XRD pattern of the Ni-Cu nanowires formed in the intermediate stage of reaction.

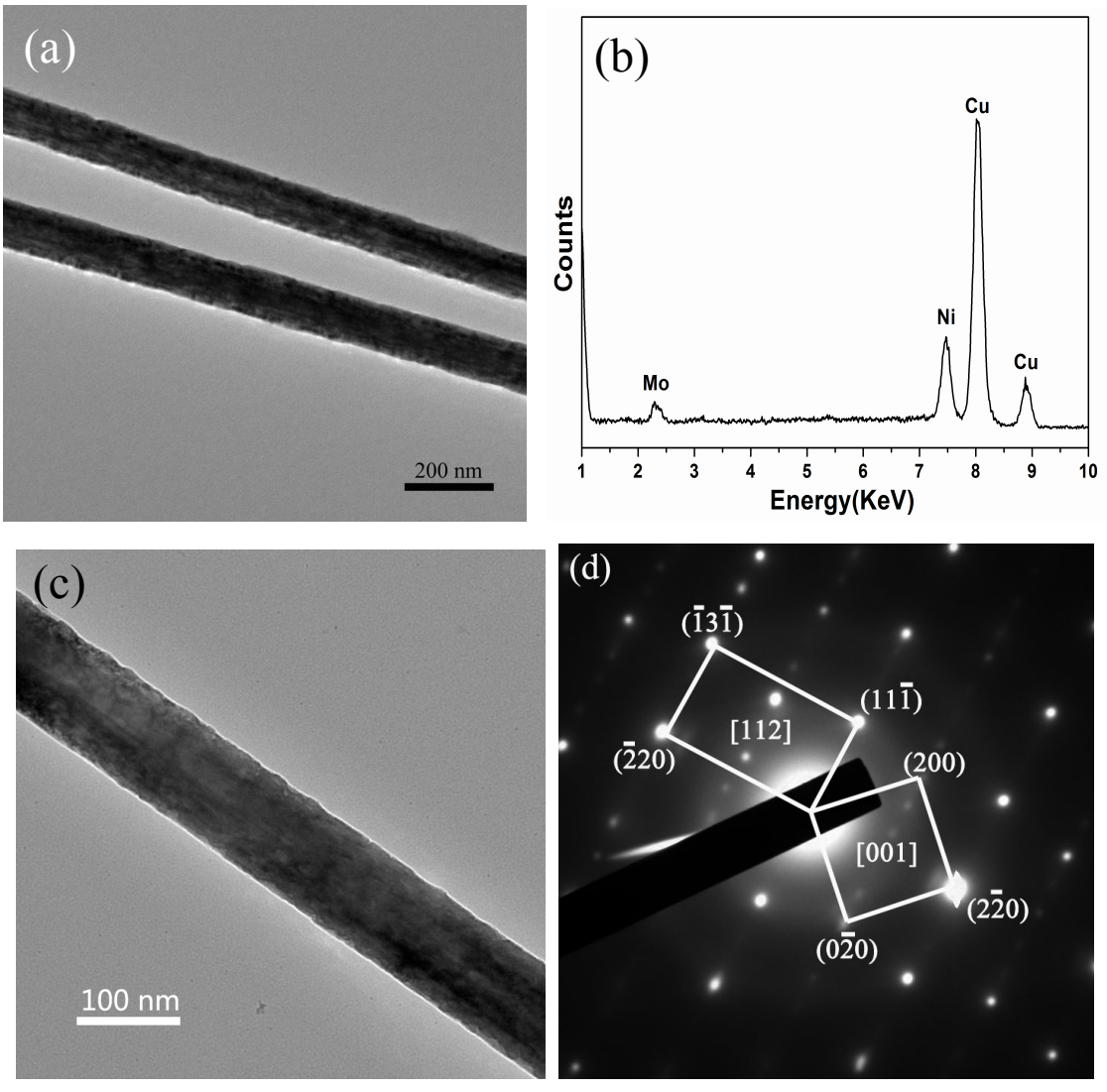


Fig. S4 (a) and (b) are the TEM image and EDS spectrum of the Ni-Cu nanowires formed in the intermediate stage of reaction, respectively. (c) and (d) are the TEM image and SAED pattern from a single Ni-Cu nanowire, respectively.

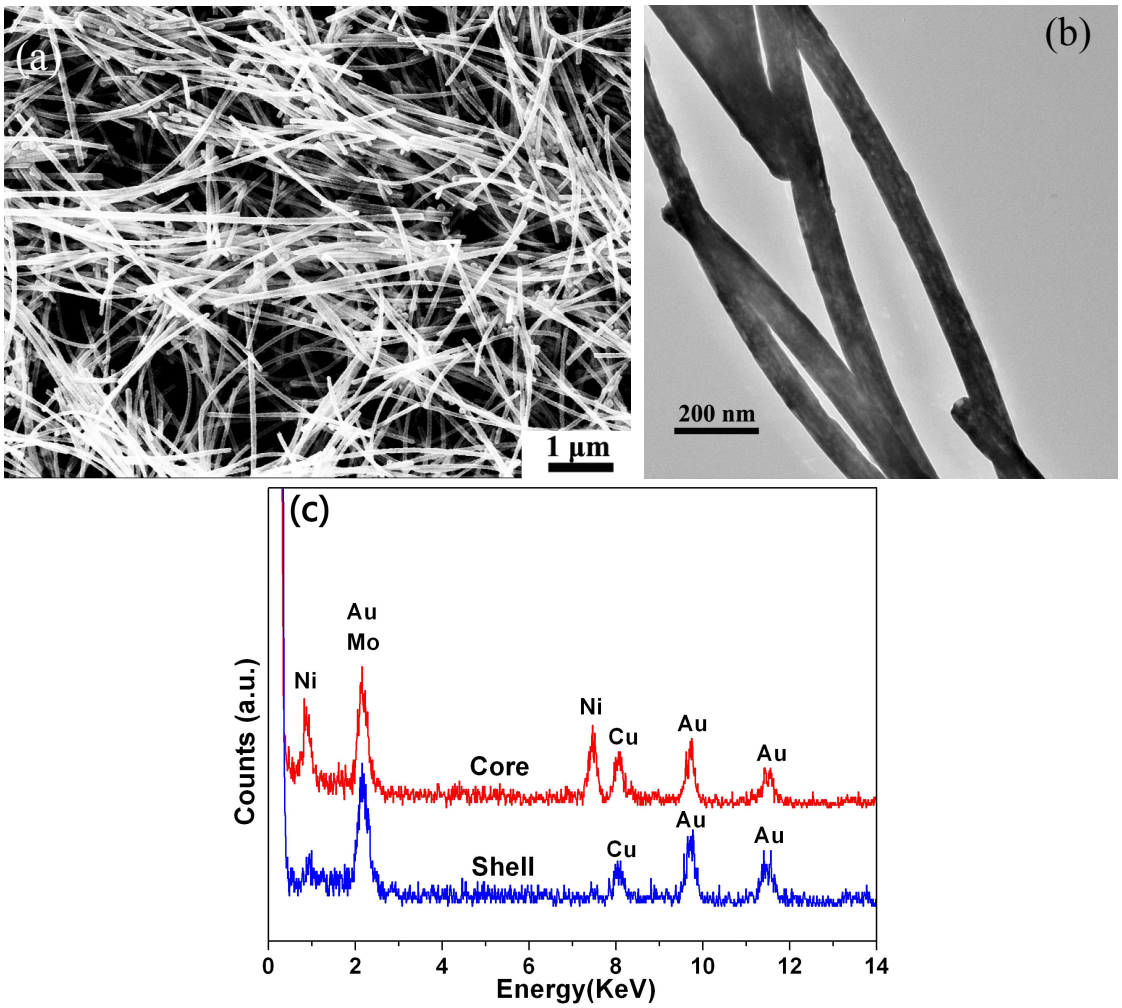


Fig. S5 SEM image (a), TEM images (b) and EDS spectra (c) of Ni-Cu@Au-Cu nanowires synthesized using 0.15 g of Au precursor.

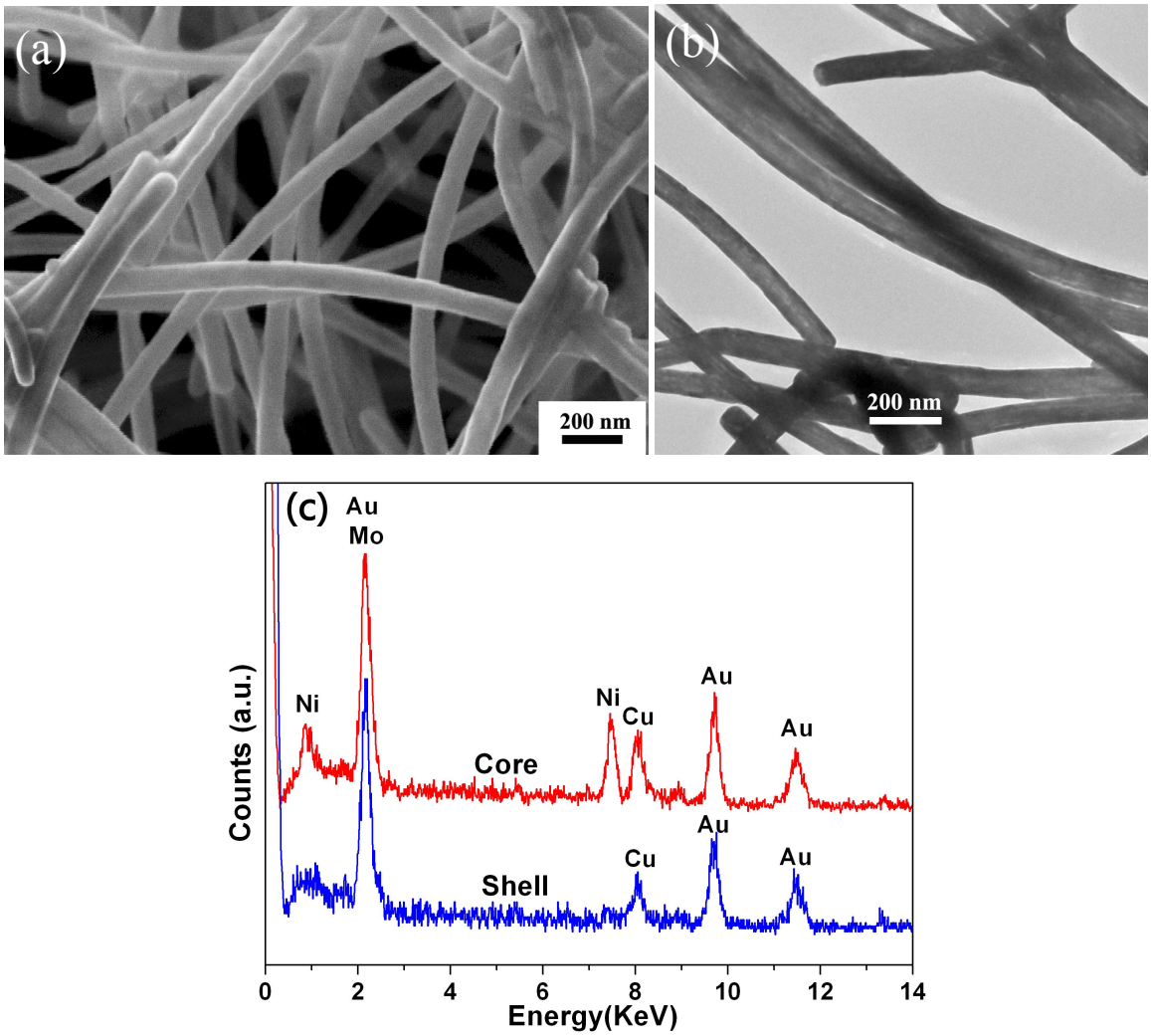
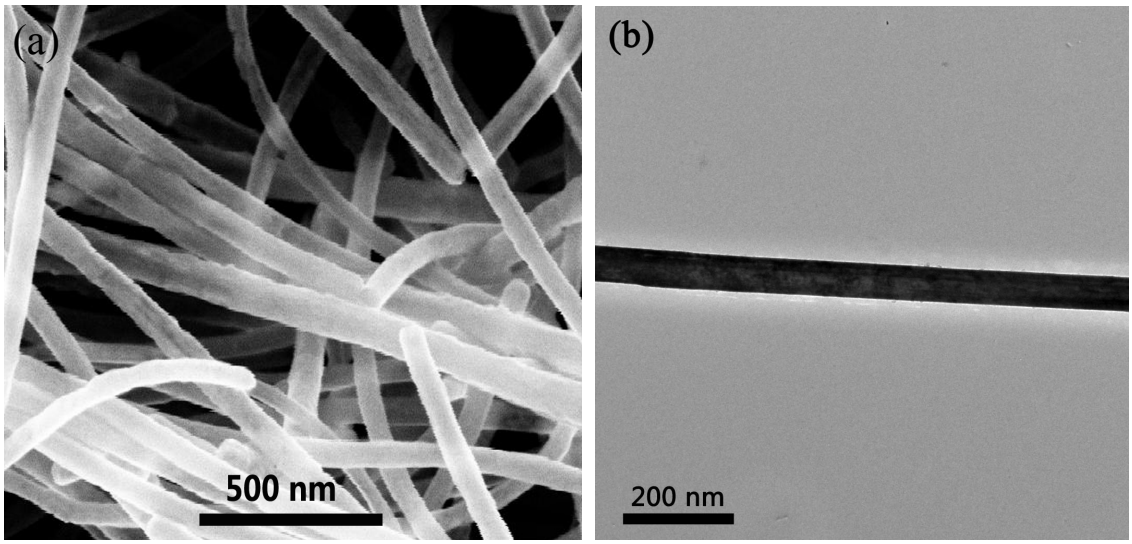


Fig. S6 SEM image (a), TEM images (b) and EDS spectra (c) of Ni-Cu@Au-Cu nanowires synthesized using 0.4 g of Au precursor.



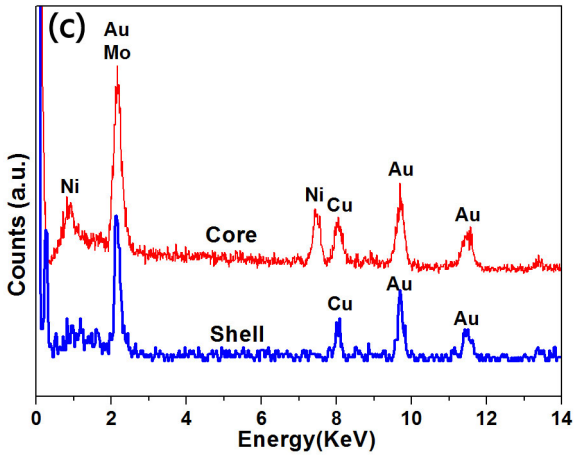
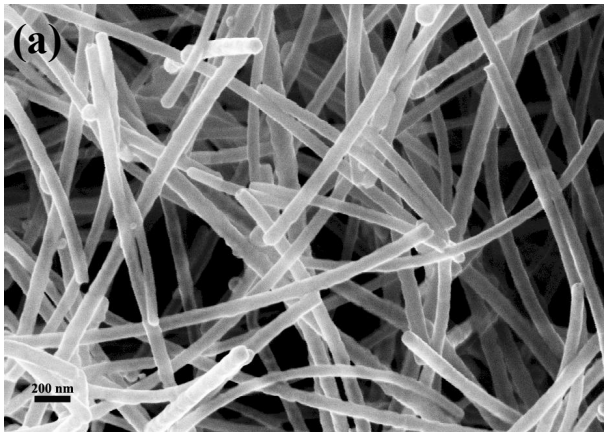


Fig. S7 SEM image (a), TEM images (b) and EDS spectra (c) of Ni-Cu@Au-Cu nanowires synthesized using 0.5 g of Au precursor.



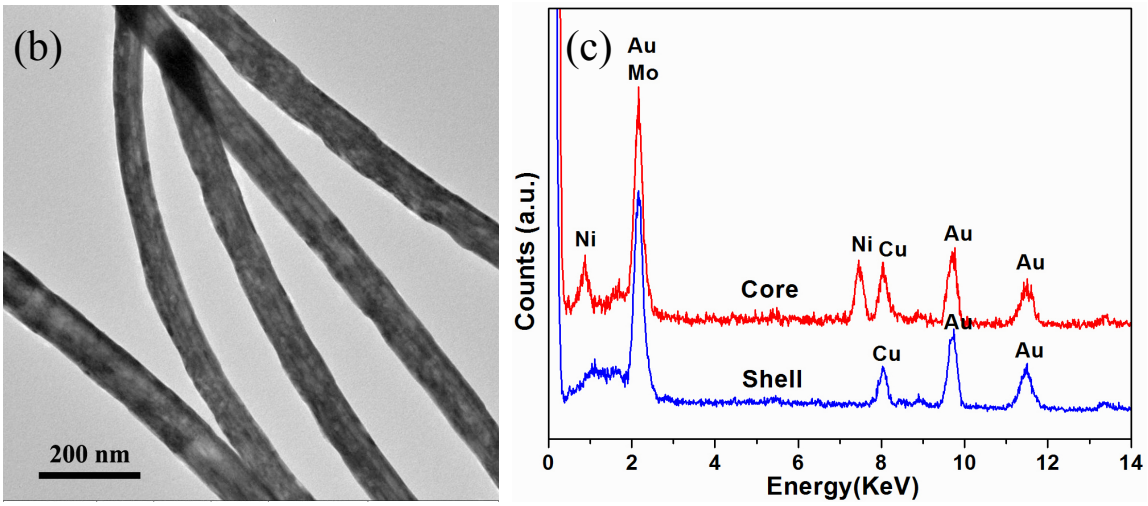


Fig. S8 SEM (a) and TEM (b) images and EDS spectra (c) of the Ni-Cu@Au-Cu nanowires synthesized including a step aging at 195 °C in 60 min.

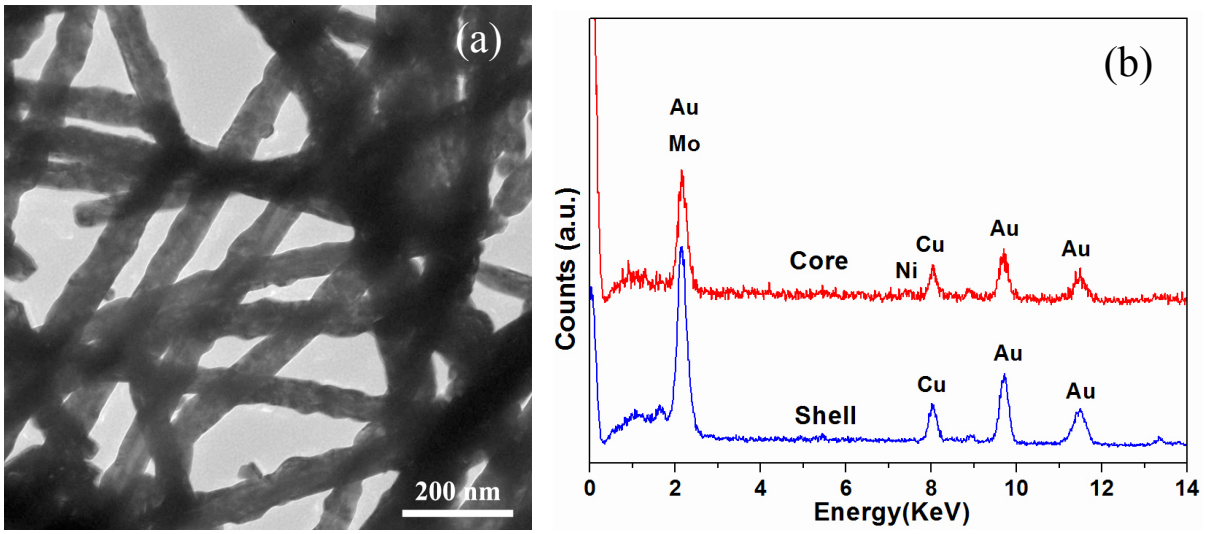


Fig. S9 TEM image (a) and EDS spectra (b) of the nanowires synthesized including a step aging at 185 °C in 60 min.

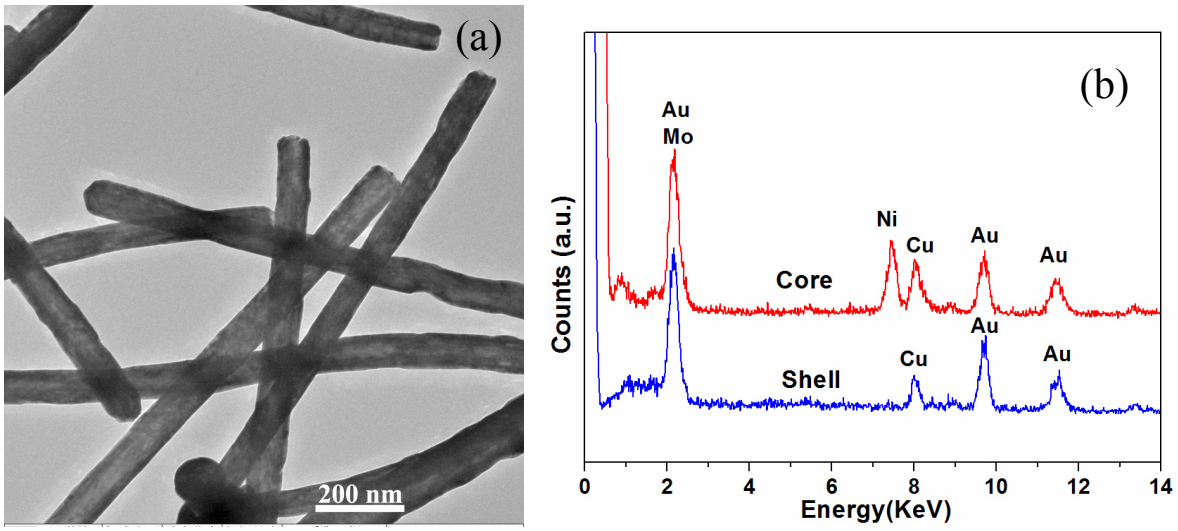


Fig. S10 TEM image (a) and EDS spectra (b) of Ni-Cu@Au-Cu nanowires synthesized including a step aging at 205 °C in 60 min.

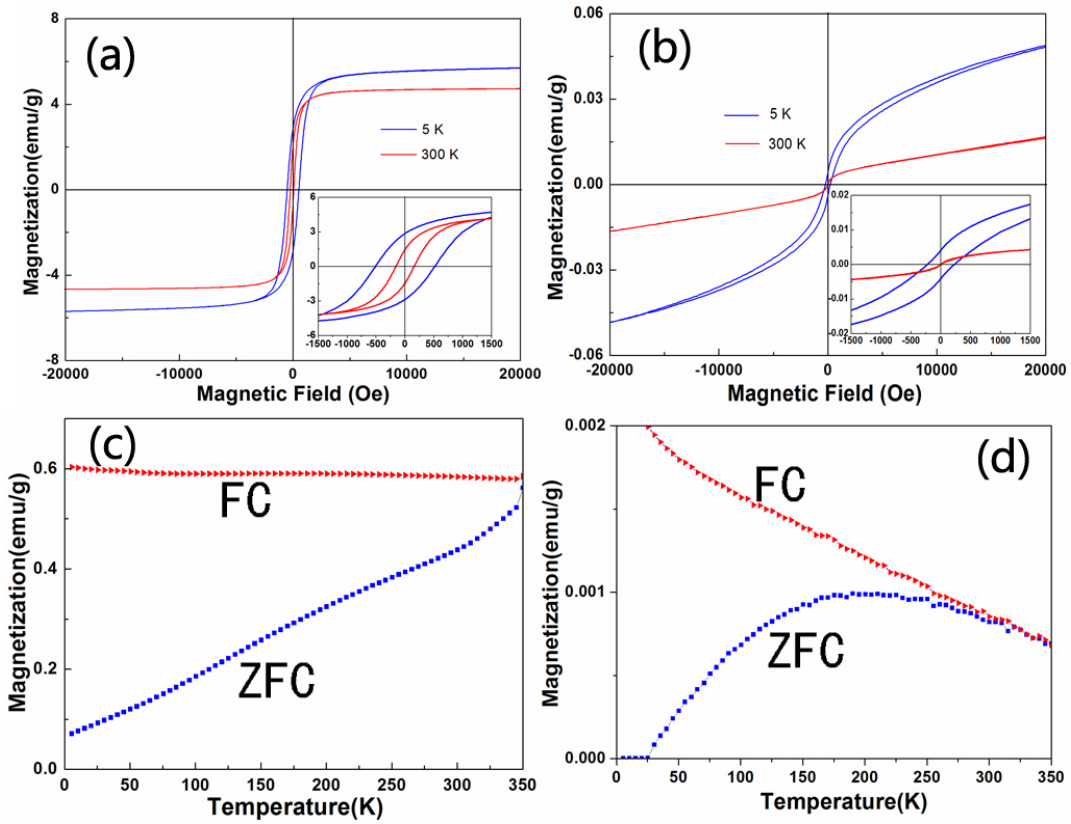


Fig. S11 (a) and (c) are the magnetic hysteresis loops and ZFC-FC (100 Oe) curves of the Ni-Cu@Au-Cu nanowire sample obtained including a step aging at 205 °C for 60 min. (b) and (d) are the magnetic hysteresis loops and ZFC-FC (100 Oe) curves of the Ni-Cu@Au-Cu nanowire sample obtained including a step aging at 185 °C for 60 min.

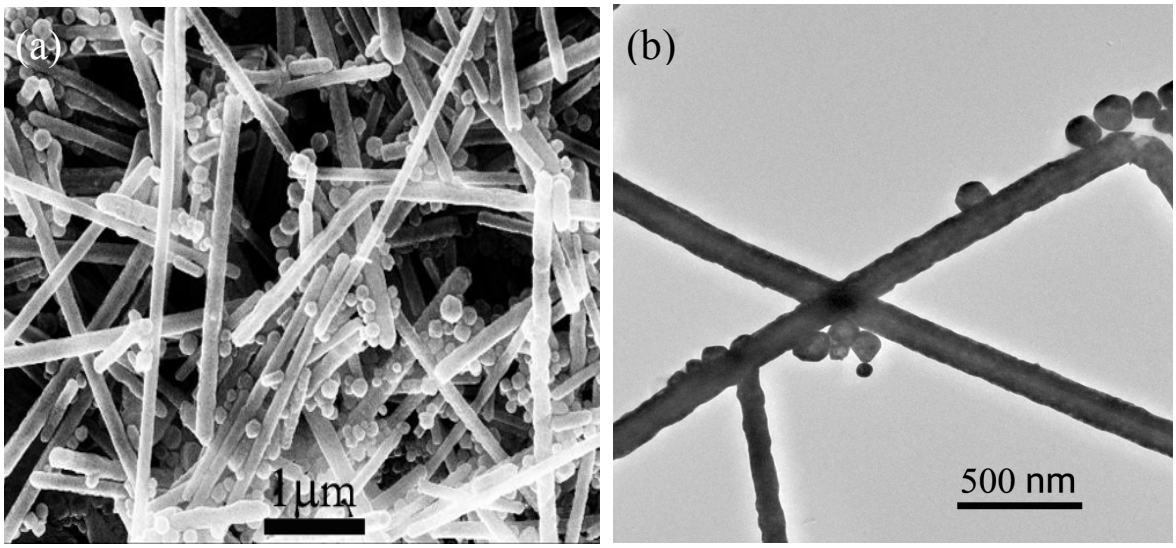


Fig. S12 SEM image (a) and TEM image (b) of the Ni-Cu@Au-Cu nanowires synthesized by reacting $Ni(acac)_2$, $CuCl_2 \cdot 2H_2O$, oleylamine and octadecylene together with other parameters unchanged at first, i.e. via a one-pot reaction instead of continuously injection. Then the Au precursor was added to form alloy shell using normal procedures described in the experimental section.