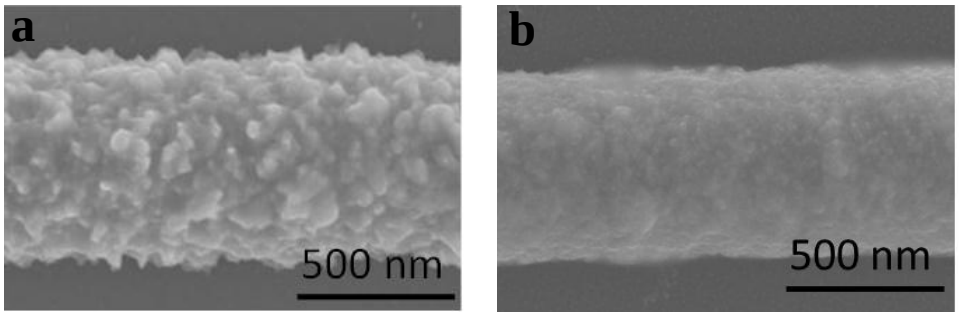
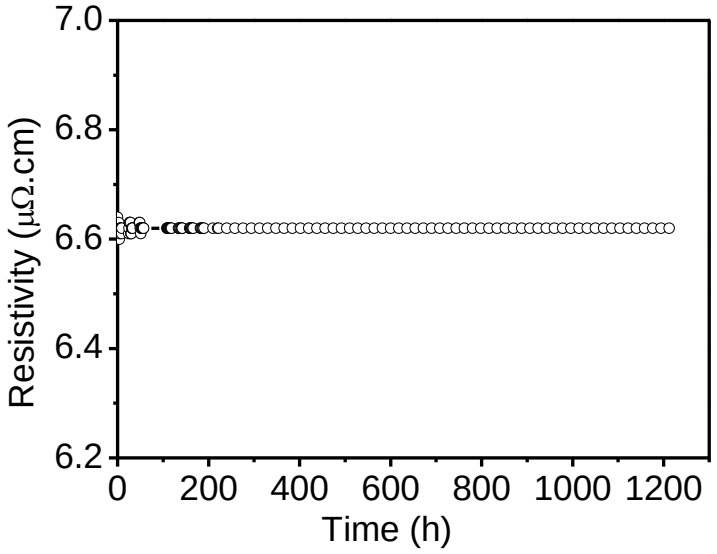
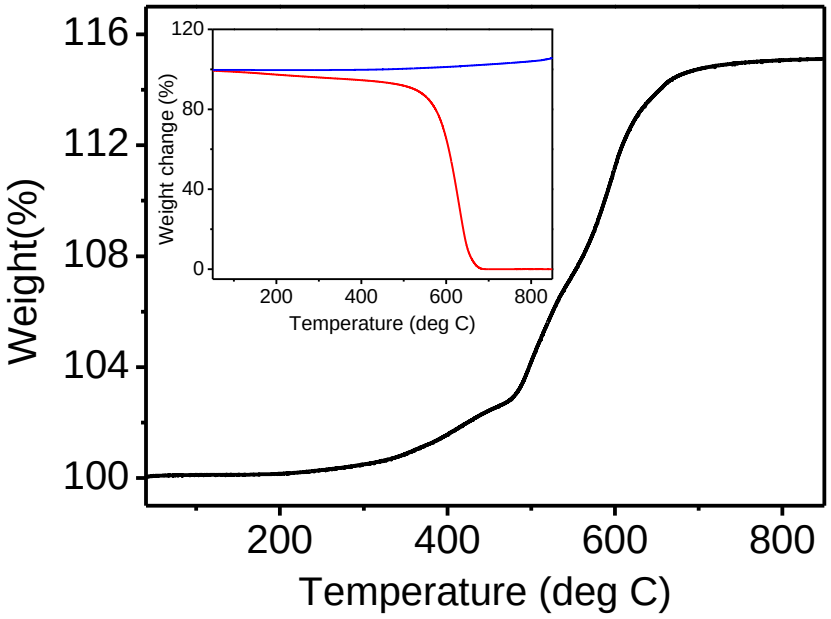


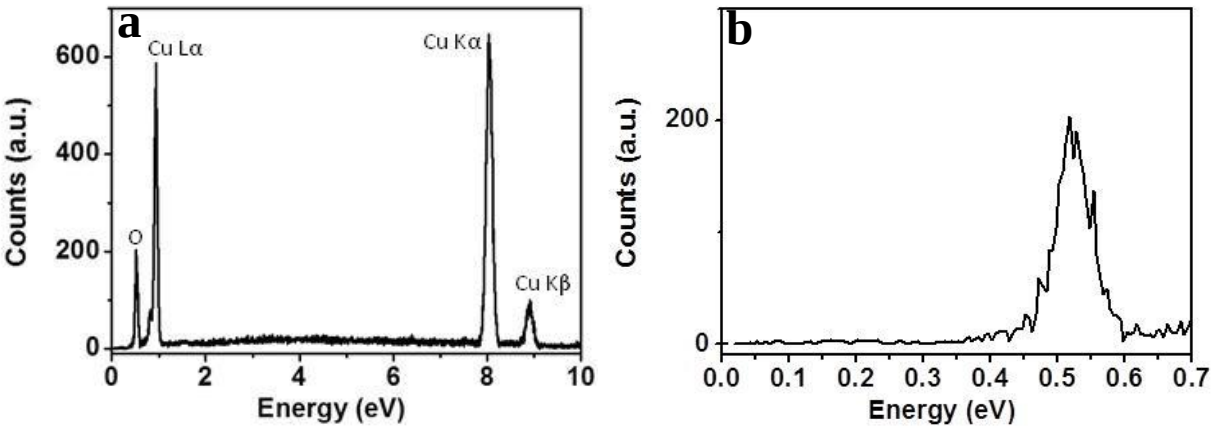
Supplementary Figure S1. Recrystallization of CNT-Cu composite during Ampacity measurement. Scanning electron microscopy images of CNT-Cu composite **a,** before and **b,** during the ampacity test. **b,** was recorded after subjecting the test structure to a current density of 6×10^{6} Acm^{-2} (where pure Cu fails). The morphology shows a clear smoothing and recrystallization. The resistivity changes from 23.8×10^{-6} Ω.cm to 4.3×10^{-6} Ω.cm.



Supplementary Figure S2. Lifetime testing of CNT-Cu composite. Variation of resistivity of CNT-Cu composite with time under a constant DC current stress of 1 x 10^8 Acm^{-2}. An invariant resistivity for over 1200 hours of testing indicates a very stable material.



Supplementary Figure S3. Thermogravimetric (TG) measurements and analysis of CNT-Cu composite. Thermogravimetric data of CNT-Cu composite recorded in oxygen-rich ambience. Inset, similar data for pure CNT (red trace) and pure Cu(blue trace) are given for comparison. CNT-Cu composite shows an weight gain due to oxidation of copper. Assuming a complete burn-out of CNT and a complete oxidation of Cu, the following equation is formed: $2Cu + C_{CNT} + 2O_2 = 2CuO + C_{CNT}O_2$. The weight fraction of Cu and CNT were estimated based on this equation. The corresponding volume fractions is estimated from their densities (Cu = 8.9 gcm^{-3}, CNT solid = 0.5 gcm^{-3}). The complete burn-out of CNT during TGA is supported by the fact that we did not find any residual carbon in energy-dispersive X-ray (EDX) analysis of the sample after TG, as shown in Supplementary Figure S4.



Supplementary Figure S4. EDX data. a, Energy dispersive X-ray analysis of the CNT-Cu composite sample after TGA. Prominent Cu and O peaks are observed indicating complete oxidation of Cu during TGA. **b,** Absence of carbon peak indicated complete burn-out of the CNT during TGA, validating our assumption.