## Up to 19-fold Thermal Conductivity Increase of Carbon Nanotube Bundles toward High-end Thermal Design Applications

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High temperature annealing (between 800 °C and 3000 °C) provides a simple and efficient way for purifying carbon nanotubes (CNTs) materials in large scale. To study the dynamic thermal properties evolution with increasing annealing temperature and avoid statistical error from sample-wide structure variation and sample transfer/preparation, the sequential process of current-induced thermal annealing (CITA) on improving the structure, electrical and thermal conductivity of CVD grown CNT bundles is studied for the first time by combining CITA in vacuum environment and in-situ afterwards transient electro-thermal (TET) characterization. The in-situ dynamic and evolving electrical resistance and effective thermal diffusivity ( $\alpha$ ) profile during annealing is accurately obtained. The  $\alpha$  and thermal conductivity ( $\kappa$ ) before and after CITA are measured from room temperature down to 10 K, which uncovers the defects density reduction and inter-tube connection enhancement after CITA. The varied annealing effect along the sample length is revealed by Raman spectroscopy result. The center point  $\kappa$  against annealing temperature are uncovered based on numerical modeling of the experiment. The resulting intrinsic  $\kappa$  of graphite walls has a 5-19 time increase by CITA, and reaches as high as 754 W/m·K.