Optical and Thermoelectric Properties of Ultrahigh-Conductivity Double-Wall Carbon Nanotube Films and Fibers

◦Natsumi Komatsu[1], Yota Ichinose[2], Oliver S. Dewey[1], Lauren W. Taylor[1], Mitchell Trafford[1], Yohei Yomogida[2], Matteo Pasquali[1], Kazuhiro Yanagi[2], and Junichiro Kono[1]

Rice University[1], Tokyo Metropolitan University[2]

E-mail: nk31@rice.edu, kono@rice.edu

Recently, it has been shown that macroscopically aligned metallic carbon nanotube films with an optimized Fermi energy (E_F) are promising for thermoelectric applications [1]. They exhibited surprisingly high power factors (σS^2), maintaining both high values of Seebeck coefficient (S) and electrical conductivity (σ) due to sharp features in the electronic density of states near the E_F. Here, we chemically changed the E_F of aligned double-wall carbon nanotube (DWCNT) films and fibers and studied their optical and thermoelectric properties. Figure 1a shows absorbance spectra for chlorosulfonic acid (CSA) doped and annealed DWCNT films prepared by a facile blade coating technique [2]. The E_{11} and E_{22} exciton peaks in outer-wall semiconducting CNTs (S^o_{11} and S^o_{22}) are suppressed in the CSA-doped film due to Pauli blocking, allowing us to estimate E_F. Then we prepared aligned DWCNT fibers by a CSA solution spinning technique [3], chemically tuned E_F, and obtained a power factor value of 14±5 $mWm^{-1}K^{-2}$, which is the highest *p*-type power factor ever achieved at room temperature (Figure 1b).

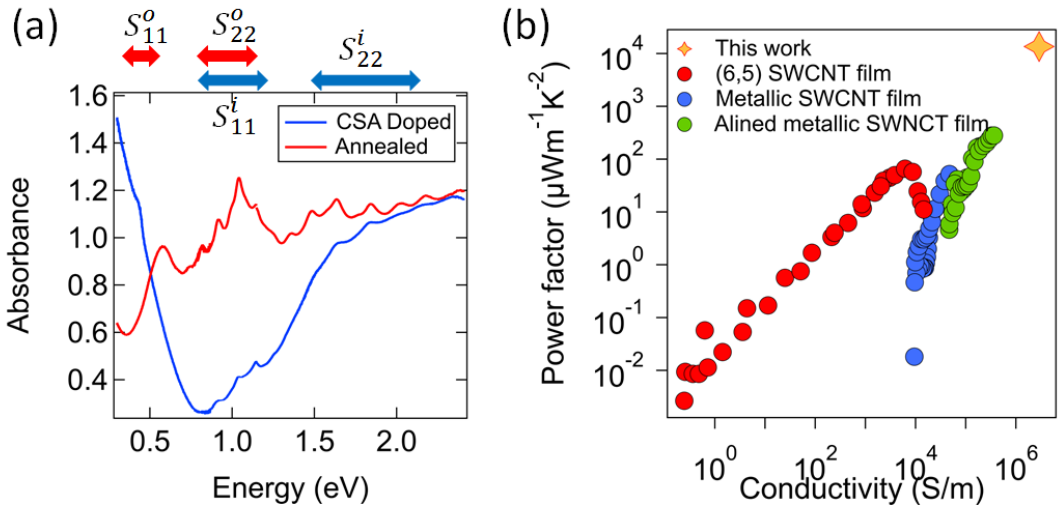

Figure 1. (a) Absorbance spectra for doped and annealed films of aligned DWCNTs. (b) Comparison of power factor values measred for CNT-based systems [1].

References:

[1] Y. Ichinose *et al.*, *Nano Lett.*, vol. 19, no. 10, p. 7370, 2019.

[2] R. J. Headrick *et al.*, *Adv. Mater.*, vol. 30, no. 9, p. 1704482, 2018.

[3] N. Behabtu *et al.*, *Science*, vol. 339, no. 6116, p. 182, 2013.