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Rapid High-Yield Dispersions of Large-Diameter Semiconducting Single-Walled Carbon Nanotubes with Tunable Narrow Chirality Distributions

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We report on the ability to produce high-throughput dispersions of large-diameter (<d> ≈ 1.3 nm) semiconducting single-walled carbon nanotubes (SWCNTs) using organic semiconducting polymers. Previous methods have struggled to reach purities and yields needed for large-scale production of devices. Our rapid processing and high yields combined with undetectable quantities of metallic SWCNTs lends itself to easily incorporating these semiconducting SWCNTs into commercially scalable applications such as high-efficiency field-effect transistors and solar cells.

We further report on the ability to tune the chiral distribution by modifying the synthesis temperature of our laser vaporization (LV) SWCNTs and selecting an appropriate polymer. The diameter range of the LV SWCNTs moves toward larger diameters (1.4 nm) with higher synthesis temperature and smaller diameters (0.8 nm) with lower synthesis temperature. For applications that require large quantities of type-pure semiconducting SWCNTs, we can use an unselective polymer to disperse most semiconducting chiralities. For narrow chiral distributions, we are able to select near-armchair semiconducting SWCNTs by choosing a selective polymer and the appropriate LV starting material. Photoluminescence (PL) from the polymer dispersions we create are significantly brighter and narrower than comparable aqueous dispersions and allow for quantitative PL studies of larger diameter SWCNTs.