291o Single-Walled Carbon Nanotubes as near-Infrared Fluorescence and Raman Cell Labels

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Molecular complexes of single-walled carbon nanotubes and single-stranded DNA oligonucleotides were developed as a new method for cell labeling that did not involve genetic manipulation, nuclear, or plasmalemmal dyes. The complexes are non-photobleaching even when excited at high fluence and shown to be compatible with cytochemical staining. They fluoresce and Raman scatter in the near-infrared region where biological autofluorescence is minimal and tissue penetration is optimal (800-1400 nm). We demonstrate that surface-modified carbon nanotubes undergo rapid cellular uptake and peri-nuclear cytoplasmic distribution using fluorescence imaging and Raman mapping of 3T3 cells and murine myoblast stem cells. Transmission electron microscopy confirmed peri-nuclear localization within the cytoplasm and revealed that nanotubes situate in membrane-bound vessicles. The cells, containing surface-modified carbon nanotubes, remained viable and successfully labeled after 3 months in culture, indicating potentially useful applications such as long-term biolabeling and biosensing.