Carbon Nanotube Optical Bandgap Modulation for Cancer Research and Diagnosis

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The measurement of biomarkers, drugs, and metabolites in live cells and organisms would allow for improvements in disease detection, drug development, and biomedical research. Single-walled carbon nanotubes have suitable optical properties for application as sensors for use in live cells and in vivo, including narrow, near-infrared emission bands with sensitivity to the local environment. To develop them into sensors for bioanalytes, we devised new methods to probe single-walled carbon nanotube optical properties, including near-infrared hyperspectral imaging[1] and live-tissue excitation/emission spectroscopy[2]. We also harnessed a mechanism of carbon nanotube photoluminescence optical bandgap modulation, whereby electrostatic charges mediate spectral shifts[2]. We believe that this effect is consistent with carbon nanotube solvatochromic behavior and found that this mechanism facilitates the measurement of multiple classes of bioanalytes, such as nucleic acids[3, 4], drugs[5], and proteins[6], enabling the development of in vivo implantable sensors[3, 6] for the study and detection of cancer (Fig. 1).

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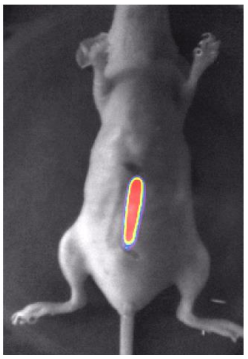

Fig 1. Near-infrared photoluminescence image of microRNA-responsive DNA-encapsulated single-walled carbon nanotubes within a membrane implanted into a live mouse.