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Near-Infrared Biological Window

The near-infrared (NIR) spectral region features several ranges that are uniquely advantageous for biological scans. At these ranges, often described as "biological windows", biological media attenuates light at orders of magnitude lower intensity than the surrounding wavelengths, making these sensors particularly useful for *in vivo* and *in vitro* applications.

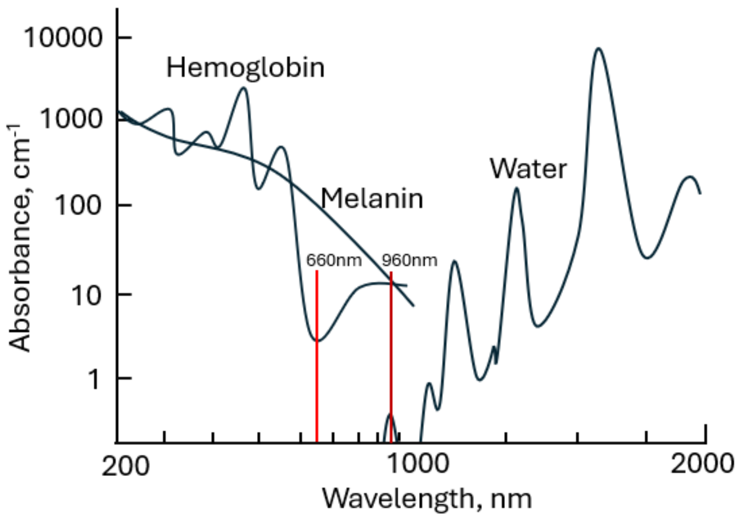

Figure 1. Characteristic absorbance spectra of absorbing biological materials around NIR biological window.

Most existing NIR transducers, however, exhibit limitations to their utility. Organic dyes, such as indocyanine green, are susceptible to photobleaching. Quantum dots exhibit "blinking" behavior, fluctuations between "ON" and "OFF" states which can contribute to inconsistent and intermittent fluorescence quality. Lastly, single-walled carbon nanotubes (SWCNTs), while photostable and consistent, generally require high-power visible excitation sources which lack the biological transparency of their NIR counterparts.

(8,3)-Chiral Single-Walled Carbon Nanotubes

One isomer of SWCNT, the (8,3)-carbon nanotube may be used to mitigate this limitation. The (8,3)-SWCNT features an excitation band at approximately 660nm and an emission band at approximately 980nm. Thus, excitation and emission wavelengths may easily pass through biological media. Additionally, the excitation band of (8,3)-SWCNTs is particularly close to the common 650nm laser line, further facilitating its use in fluorescence work.

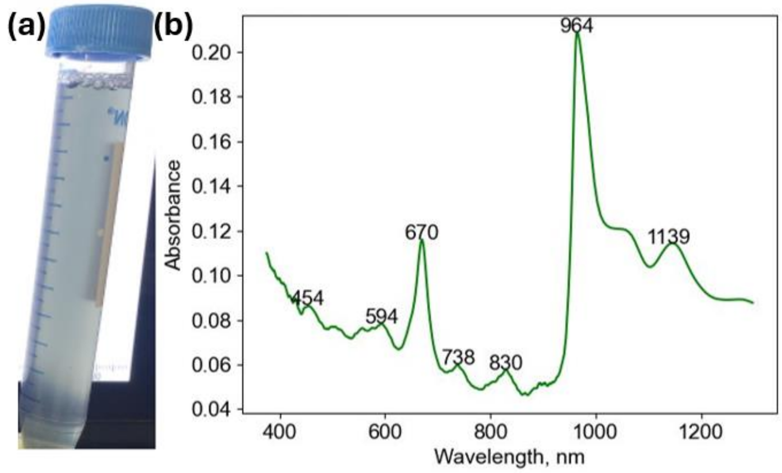

Figure 2. (a) picture of (8,3)-enriched SWCNT and (b) absorbance spectra of (8,3)-enriched SWCNT. Absorbance peaks associated with (8,3) are at 670nm and 964nm.

Easy Sources of Excitation

An NIR fluorimeter may easily be modified to excite (8,3)-SWCNT. Many different consumer-end red lasers can be used as an excitation source. Red lasers can be purchased from a variety of sources with price points below $10. These can then be inserted into fluorimetry devices as already-collimated excitation sources. Figure 3 shows one such $10 laser pointer being used in a functioning fluorimeter.

Figure 3. (Left) Sample prices of inexpensive red lasers usable for excitation. (Right) Functioning NIR fluorimeter using $10 laser pointer as excitation source.

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Bright Fluorescent Emissions

(8,3)-SWCNTs notably emit brightly when excited with a 650nm laser. Figure 4 shows overlaid emissions spectra obtained when exciting a polydisperse SWCNT sample (Chasm Technologies, SG65i) with different lasers. Although not the most abundant chirality, when excited with the 650nm laser, (8,3)-SWCNTs produce the brightest fluorescent peak, illustrating significant value for high-sensitivity biological applications.

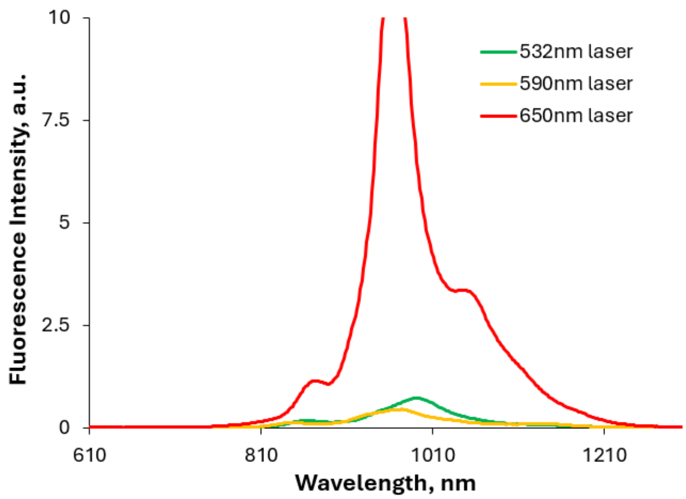

Figure 4. Overlaid emission spectra of polydisperse SWCNT excited with different laser sources.