HORIBA Scientific

Fluorescence Technical Note FL-31

The NanoLog® Series: A New Generation of Performance

Introduction

The NanoLog® (Fig. 1) has a reputation as the premier instrument for the exploration of single-walled carbon nanotubes (SWCNTs). Derived from the Fluorolog® series of the World's Most Sensitive Spectrofluorometers, the Nanolog® now benefits from improved sensitivity, plus features and software that extend its applications and configurations into new research possiblities. Experiments can run faster, increasing sample throughput and laboratory efficiency. Higher sensitivity means detection of species previously unmeasurable. In addition, an absorption accessory lets researchers measure the absorbance and transmittance of samples, to account for inner-filter effects and re-absorption phenomena that alter observed fluorescence-peak intensities. Our exclusive NanoSizer software then can correct for these effects.

Fig. 1. *NanoLog® spectrofluorometer.*

Experiments and results

To demonstrate the instrument's sensitivity, (6,5) SG SWCNT (CoMoCAT, SouthWest NanoTechnologies[1]) was used (0.1 mg L^{-1} in D_2O, + 0.1% NaDDBs). The sample was placed into a 1-cm path-length cuvette inside the instrument with right-angle optics. The spectrofluorometer used a $N_2(l)$-cooled 1″ InGaAs 512 × 1 array detector, and a Schott RG830 cut-on filter (λ > 830 nm) in the emission path. With 10 nm bandpass and 2 × 5 s = 10 s integration time, the scan was centered at 1210 nm. The excitation and emission spectrometer gratings were 100 grooves mm^{-1}, blazed at 800 nm.

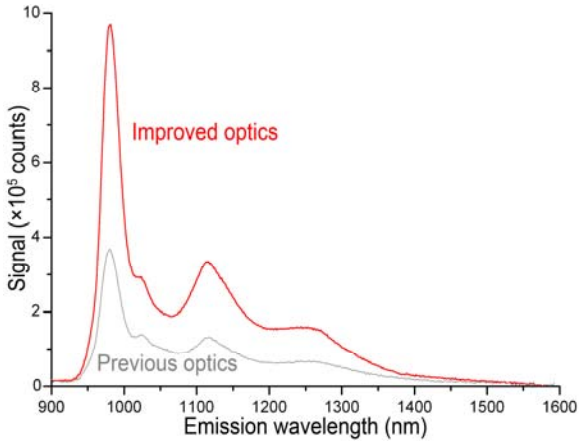

Fig. 2. *Signal from the SWCNT sample. Gray: original system; red: improved instrument.*

Photoluminescence from the sample was collected at λ_{exc} = 568 nm. Fig. 2 compares fluorescence from the original

[1]SouthWest NanoTechnologies, Inc., 2501 Technology Place, Norman, OK 73071-1102

(gray) and the latest system (red), showing signal three times higher.

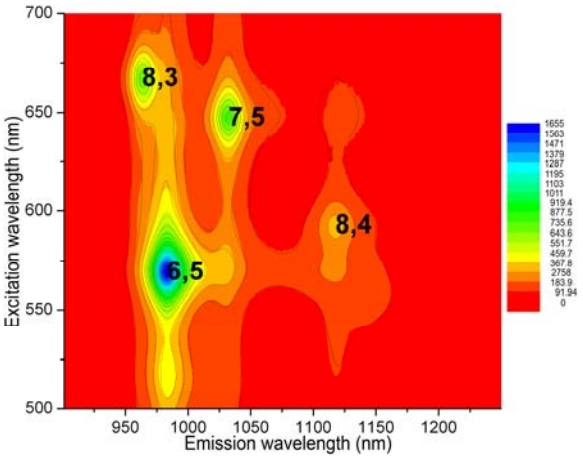

Fig. 3. *EEM of NIST sample. Important SWCNTs (>10% of maximum) are labeled with (n,m) coordinates.*

The signal-to-noise ratio (*S*/*N*) determination used the same experimental parameters. The SWCNT sample[1], in a 0.5-cm path-length rectangular cuvette, was diluted (A ≈ 0.09) and scanned from 828–1520 nm. Calculated[2] *S*/*N* = 19 200 from the (6,5) peak and average blank signals. HORIBA Scientific's Nanosizer software created a corrected[3] EEM (Fig. 3); prominent peaks are labeled. The Nanosizer software also plotted a helix-angle map of the SWCNT sample's components (Fig. 4). The absorption accessory (Fig. 5) placed in the sample compartment recorded A = 0.72 at 982 nm (Fig. 6, next page) from fraction 9 of the CoMoCAT sample.

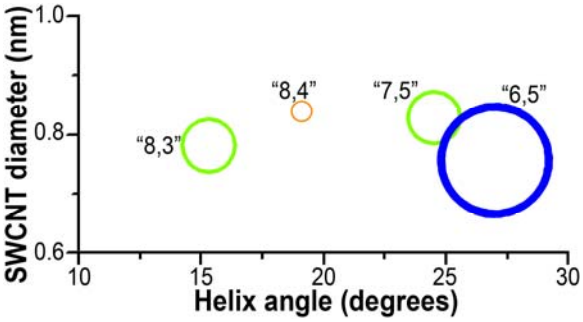

Fig. 4. *NIST SWCNT diameters vs. helix-angle. Circles' diameters are proportional to intensities shown in Fig. 3.*

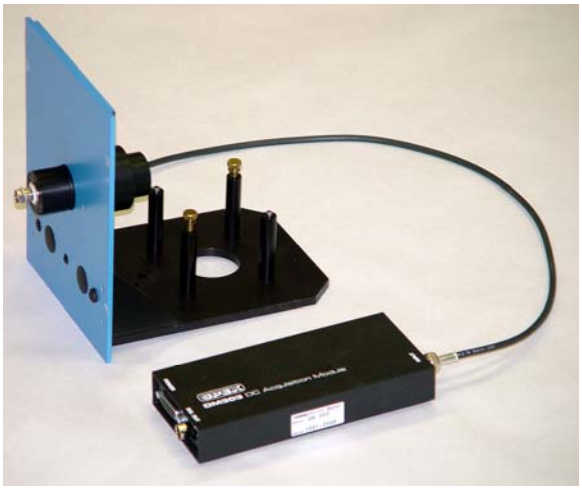

Fig. 5. *Absorption accessory.*

Conclusions

HORIBA Scientific has extended the performance of the NanoLog® spectrofluorometer with an absorbance accessory plus heightened sensitivity for faster throughput, more signal, and greater *S*/*N*. The absorption accessory offers better stability, precision, and speed for experiments requiring immediate absorption measurements concurrent

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[2] Peak signal = 78 933, average blank signal from 828–1520 nm) = 16.8.

$S/N = (78933 - 16.8)/\sqrt{16.8} = 19200$

[3] P.C. DeRose, *et al.*, "Qualification of a fluorescence spectrometer for measuring true fluorescence spectra", *Rev. Sci. Instrum.* **78**, (2007), 033107.

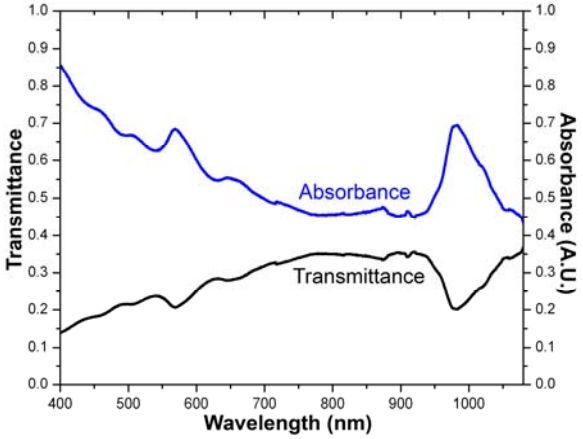

Fig. 6. *Transmittance (black) and absorbance (blue) from the CoMoCAT sample's fraction 9. Slits = 5 nm bandpass; integration time = 0.1 s.*

with fluorescence scans. Experiments with the absorption accessory also can be applied to both metallic and semi-conductor SWCNT samples.