東京大学グローバルCOEプログラム　機械システム・イノベーション国際拠点

東京大学 THE UNIVERSITY OF TOKYO

GMSI Global Center of Excellence for Mechanical Systems Innovation

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Fluorescence of Single-Walled Carbon Nanotubes: Applications in Physics, Chemistry, and Bio-medicine

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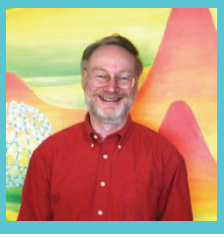

日時：2010年 2月18日（木）　11：00 － 12：30
会場：東京大学工学部2号館　3F　31A会議室

要旨

Single-walled carbon nanotubes (SWCNTs) are artificial nanostructures of great interest to basic and applied researchers because of their remarkable mechanical, thermal, electronic, and optical properties. SWCNTs are formed in a variety of well defined structures, most of which have semiconducting band gaps that depend on nanotube diameter and roll-up angle. The 2002 discovery and interpretation of near-infrared band gap photoluminescence (fluorescence) from semiconducting nanotubes have led to a wide range of studies, some of which will be surveyed here.

In one topic, near-IR fluorescence microscopy is used to investigate the photophysical properties of individual SWCNTs. Calibrated photometric measurements on selected nanotubes have now provided absolute intrinsic values of fluorescence action cross-sections for 31 different structures. These results show significant structural variations in fluorescence brightness among nanotubes. They have been empirically fitted in order to extrapolate the findings to additional structures and thereby allow fluorimetry to give the first quantitative analyses of mixed SWCNT samples. A new multi-mode instrument has been developed to measure absorption, near-IR emission, and Raman spectra of such samples. Individual nanotubes were also observed in fluorescence microscopy while they were exposed to chemical reactants that quench the emission. Stepwise changes in emission intensity were clearly observed and identified as single-molecule reaction events. Analysis of these steps revealed that each sidewall reactive event quenches excitons within a ~100 nm region of the nanotube surrounding the reaction site. Near-IR fluorescence also appears useful in developing SWCNT biomedical applications. In the first observation of nanotubes inside a living organism, SWCNTs have been imaged inside fruit fly larvae that had eaten food containing nanotubes. No adverse effects of SWCNT ingestion on viability were found. Individual SWCNTs could be imaged and structurally identified inside dissected tissues. Near-IR fluorescence has also been used to measure SWCNT removal kinetics from the blood stream of rabbits following intravenous injection. These results are relevant to future medical uses of carbon nanotubes.

主催：　東京大学グローバルCOEプログラム「機械システム・イノベーション国際拠点」
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