单壁碳纳米管(SWNT)的直径测定

SWNT Diameter Measurement

拉曼分光光度计与扫描探针显微镜

Raman Spectrophotometer & Scanning Probe Microscope

HoloLab-Series5000 & SPM-9500J3

通过拉曼光谱测定SWNT的直径

在SWNT的拉曼光谱图中，可在300~100cm-1范围内观察到被称为RBM(径向呼吸模)的峰。该峰与纳米管直径的伸缩振动相对应，并且该振动数与直径成反比，因此可用来估计直径。具体来说，用某系数（通常用248）除以RBM的振动数即可得到直径（nm）。图1为激光喷镀法做成的SWNT的拉曼光谱图。根据RBM的振动数，可算出纳米管的直径为1.35nm。但是，由于CNT的拉曼散射受共鸣拉曼的支配，从单一激发波长的结果不能得到直径分布状况。

SWNT Diameter Evaluation by Raman Spectrophotometer

A so-called RBM (radial breathing mode) peak is observed around 300 to 100cm^{-1} in the Raman spectrum of single-wall carbon nanotubes (SWNT). This corresponds to vibrations due to expansions and contractions of the nanotube diameter. As the frequency is proportional to the reciprocal of the diameter, it can be used to estimate the nanotube diameter. In practice, the diameter (in nanometers) is calculated by dividing a coefficient (normally 248) by the RBM frequency. Fig.1 shows the Raman spectrum of SWNT created by laser vaporization. A nanotube diameter of 1.35nm was calculated from the RBM frequency. However, as resonance Raman scattering is dominant for carbon nanotubes (CNT), the diameter distribution cannot be determined from a single excitation wavelength.

通过SPM测定SWNT的直径

扫描探针显微镜（SPM）的分辨率仅次于透射电镜，而且图像的垂直分辨率高，因此能够准确的测定每根CNT的直径（把直径作为高度）。图2为SWNT的测定数据。由于CNT直径的测定位置不同，直径分别为1.3nm及1.72nm。

SWNT Diameter Evaluation by SPM

The Scanning Probe Microscope (SPM) is second in resolution only to the Transmission Electron Microscope and creates images with good vertical resolution. The SPM can accurately measure the diameter of individual CNT in the height direction. Fig.2 shows SWNT measurement data. It indicates that the diameter is 1.3nm and 1.72nm at different measurement positions.

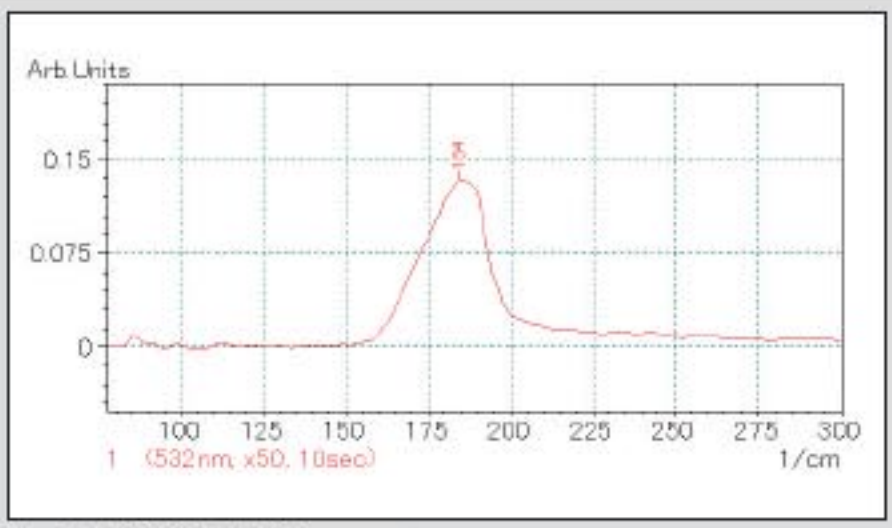

图1 SWNT的拉曼光谱

Fig.1 Raman Spectrum of SWNT

激发波长：532nm 照射时间：10秒 物镜：50倍

Excitation: 532nm Exposure: 10s 50x objective

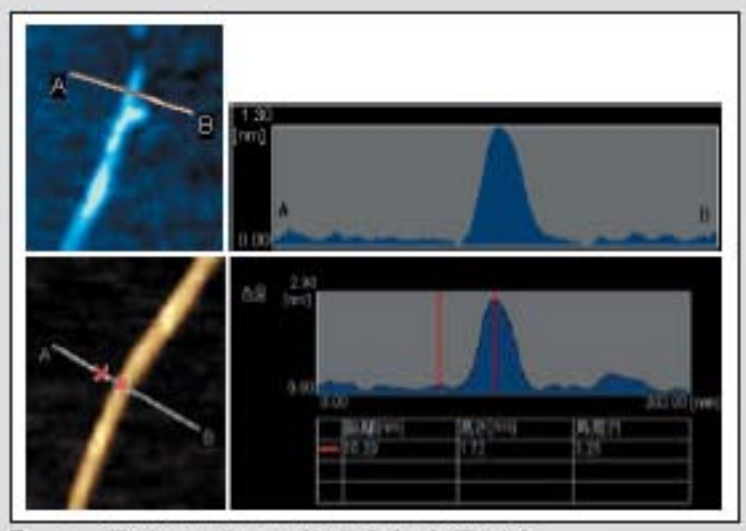

图2：通过SPM对SWNT的观察与直径测定

Fig.2 SWNT Observations and Diameter Measurement by SPM

样品提供：名古屋大学研究生院 理学研究科 筱原研究室

岛津国际贸易(上海)有限公司 大型分析仪器部

北京：010-85252365 上海：021-64454065 广州：020-87108619

用户服务热线电话：800-810-0439 400-650-0439

欢迎访问http://www.shimadzu.com.cn