Interaction between Phonons in a Single-Walled Carbon Nanotube and Near-field light of an Optical Nanofiber

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The Raman scattering spectrum reflects the state of lattice vibration (phonons) in a material. Phonons contribute to the heat conduction of single-walled carbon nanotubes (SWCNTs), which are one-dimensional materials with a diameter of about 1 nm. In this study, we developed a measurement system to study the interaction between SWCNT phonons and near-field light. The sample used was a nanofiber on which an aqueous solution containing SWCNTs was applied. Raman spectra were obtained in the far-field by passing an excitation laser of 785 nm through the nanofiber. Raman measurements were performed at intervals of 5 μm over the 4 mm length of the nanofiber region. The observation results are shown in Fig. 1. While scattered light (Fig. 1a) originated from not only SWCNTs but also dust particles, the observation of the Raman G-band (Fig. 1b) allowed us to identify SWCNTs. A high G-band intensity with almost no scattered light indicated the presence of pure SWCNTs. We scanned the nanofiber surface for isolated SWCNTs this principle and performed detailed analyses. As an example, from the Raman spectrum shown in Fig. 1 (c), it can be ascertained that an isolated (10,6) SWCNT is present at this position on the nanofiber. In the presentation, we will also discuss the interaction between SWCNTs and polarized light passing though the nanofiber.

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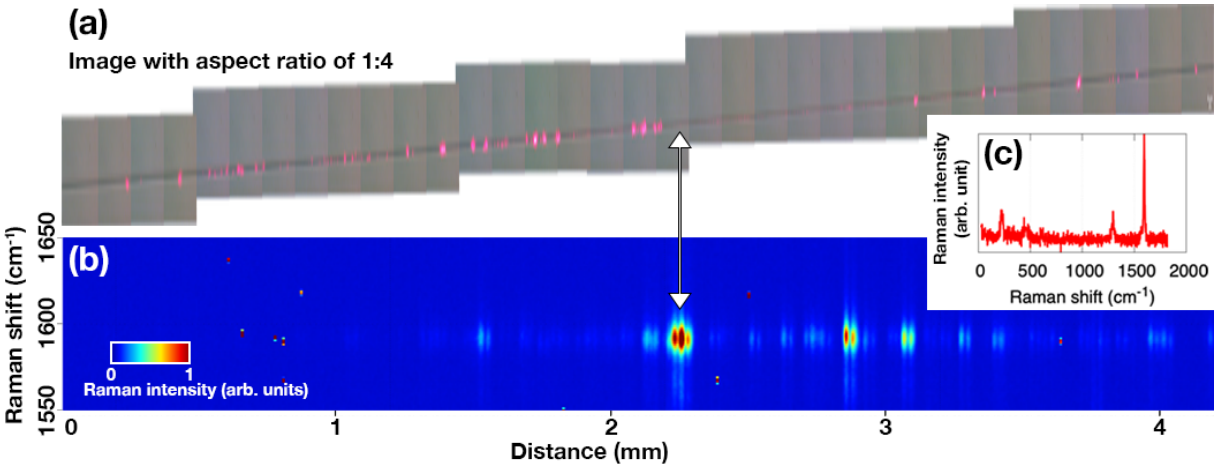

Fig. 1　Correspondence between scattered light and G-band when light passes through nanofiber to which SWCNTs are attached. (a) Optical microscope image. (b) G-band intensity measured at the position corresponding to (a). The arrows show in (a,b) indicate the results measured at the corresponding positions. (c) Near-field-excited Raman spectrum observed from an isolated SWCNT.