RAMAN FREQUENCY VARIATION WITH EXCITATION WAVELENGTHS FOR SiC NRS

Jia Shao\textsuperscript{1}, Jun Zhao\textsuperscript{1}, Yan Yan\textsuperscript{1}, Shou-Shan Fan\textsuperscript{2} and Shu-Lin Zhang\textsuperscript{1}

\textsuperscript{1} School of Physics, Peking University, Beijing 100871, China
\textsuperscript{2} Department of Physics, Tsinghua University, 100084, China. Email: slzhang@pku.edu.cn

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Abstract: The first-order Raman spectrum of SiC NRs reflects its phonon density of state. From this point we can find the decay of diameter-selective effect. Here we use different incident wavelengths to study the relation between the frequency variations of LO and TO modes in SiC NRs and incident photon energy.

SiC materials are used in wide fields, e.g., high-power electronics and photovoltaic and optoelectronic devices etc. [1, 2]. The phonon behavior is crucial for understanding the behaviors of the translation etc. in these materials. In our former works [3, 4] we have reported that the nature and the effect of excitation wavelength on intensity of Raman spectra of SiC nano rods (NRs). Here we will report on the effect of excitation wavelength on Raman frequencies for SiC NRs.

The samples used are the same to those reported in reference 3. From the TEM images of SiC NRs we can estimate that the average diameter of these NRs is about 10nm and the length is about 10\mu m. The X-ray diffraction results show that the sample possesses crystalline structure. The Raman experiments were performed in Renishaw 1000 Raman microprobe and a Fourier Raman spectrophotometer (RFS 100/s Bruker NIR-FT spectrophotometer). The sample was excited by different wavelengths in the back-scattering geometry at room temperature.

Fig 1 shows the observed SiC NRs Raman spectrum excited by 514nm line and the corresponding fitting spectra. From Fig 1 we can see that there are four peaks at 756.8cm\textsuperscript{-1}, 797.0 cm\textsuperscript{-1}, 862.0 cm\textsuperscript{-1} and 932.7 cm\textsuperscript{-1}. The peak located at 756.8cm\textsuperscript{-1} is the second order Raman mode of SiO\textsubscript{2}, which is the by-product of SiC NRs [4]. The peaks at 797.0cm\textsuperscript{-1}, 862.0cm\textsuperscript{-1} and 932.7cm\textsuperscript{-1} are the TO, interface (IF) and LO modes, respectively.
SiC NRs Raman spectra at different excitation wavelength are shown in Figure 2. The frequency variation of TO and LO with excitation wavelength is shown in Figure 3. We can see that neither the TO mode nor the LO mode frequency changes with wavelength essentially. This feature is contrary to that reported in carbon nanotubes (CNTs) [5] and Si nanowires (NWs) [6], in which the Raman frequency changes with excitation wavelengths.

![Raman spectra of SiC NRs](image1)

![Frequency variation of TO and LO modes](image2)

**Fig 2:** Raman spectra of SiC NRs excited at different wavelength.  
**Fig 3:** Frequency variation of TO and LO modes with incident photon energy.

It has been shown that the first-order Raman spectrum of SiC NRs is relative to the phonon density of states (PDOS) rather than the phonon dispersion relation, the later CNTs and Si NWs are relative to. Based on above mentioned scattering mechanism of SiC NRs and notice that the PDOS will not change with the sample size usually, the observed behavior of Raman frequency with the excitation wavelength in SiC NRs should be expected even though the sample is nano-scale material.

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