

Temperature Dependence of Raman Scatterings from Single-Walled Carbon Nanotubes

S. Chiashi, Y. Miyauchi, Y. Murakami, S. Maruyama

Department of Mechanical Engineering, The University of Tokyo

7-3-1 Hongo, Bunkyo-ku, Tokyo 113-8656, Japan

Raman scatterings from various SWNT samples were measured at a wide range of temperatures (from 4 K to about 1000 K) in the vacuum environment [1]. With increase in sample temperature, both the Raman shift and the intensity of G-band of SWNTs decreased, while the peak width increased. These temperature dependent features were compared with Raman scattering from silicon. Fig. 1 shows Raman scatterings from SWNTs on silicon substrate at different temperatures. This SWNT sample was generated on zeolite using the ACCVD method [2] and dispersed onto a silicon wafer. As the temperature increased, both the Raman shift and the intensity of the G-band and silicon peaks decreased, while the width of the peaks increased. Fig. 2 shows the relation between temperature and the Raman shift in the G-band and silicon peaks. Our data of silicon in Fig. 2 completely agree with the reference data [3]. The G-band shows almost the same temperature dependence as the silicon peak, despite different generation methods and morphologies of the samples [2,4]. The energy balance between the SWNTs, the heated silicon wafer, and the environment (vacuum for this report) determine the temperature of the SWNTs. In this case, the thermal resistance between the SWNTs and the vacuum is much larger than that between the heated silicon wafer and the SWNTs, so the temperature of the SWNTs is almost equal to that of the silicon wafer. This is one advantage of making our measurements in vacuum, since the heat transfer to a surrounding gas may otherwise result in a temperature difference between SWNTs and the silicon surface. Furthermore, it should be noted that even above their burning temperature in air the SWNTs remain undamaged in vacuum. Through these heat transfer considerations in addition to the weak laser intensity, accurate temperature dependency of Raman shift was measured for the basis of theoretical considerations.

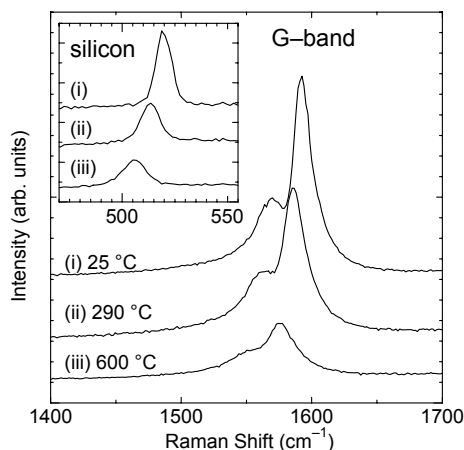


Fig. 1 Raman scatterings of SWNTs and silicon at different temperatures.

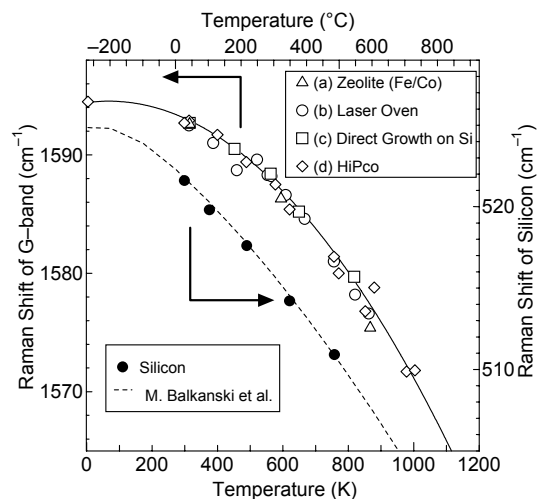


Fig. 2 Temperature dependence of the G-band.

References

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