Quantitative Composition of a SWCNT-sample:

Raman Scattering vs. Photoluminescence

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The different growth processes of Carbon Nanotubes (CNTs) yield samples containing tubes with a large variety of different chiralities. The qualitative composition of the CNTs product has been revealed by optical spectroscopy techniques such as Raman scattering [1] and Photoluminescence Excitation (PLE) measurements [2]. The quantitative composition, however, remains a task in CNT characterization.

We adress this problem by comparing the relative PLE intensities of two families of single walled carbon nanotubes with the relative intensities of the corresponding Radial Breathing Modes measured by Raman scattering. The PLE measurements were performed by dissolving the HiPCO grown nanotubes in aqueous solution using sodium dodecylbenzene sulfonate as surfactant. Raman spectroscopy was performed by depositing the tubes from the solution on a silicon substrate by spin-coating. The presence of the CNTs was confirmed by atomic force microscopy.

We show that the two methods yield significantly different ratios [3]. We propose a simple model to obtain the relative abundance of the CNT species investigated. The Raman intensities are scaled with respect to the resonance conditions of Raman scattering on carbon nanotubes [1]. Further, we include excitonic transition probabilites [4] and and electron-phonon coupling matrix elements [5]. By applying this model, we show that both the methods agree on one CNT species dominating the subset investigated.

In addition we analyse the effect of spectrometers, which use non-coherent light sources such as a *HgXe* lamp, on the PL and PLE intensities. We show that it is important to take into account both PL *and* PLE intensities [3] - rather than PL intensities only - in the interpretation of photoluminescence data of CNT.

References

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