MAPPING IMPURITY OF SINGLE-WALLED CARBON NANOTUBES IN BULK SAMPLES WITH MULTIPLEX COHERENT ANTI-STOKES RAMAN MICROSCOPY

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Single-walled carbon nanotubes (SWNT) play a very important role in nanotechnology such as in the development of biosensors and molecule stabilization. Their unique electrical and structural properties allow a good linkage between experimental and theoretical studies. All methods of carbon nanotubes synthesis produce an amount of impurity like e.g. trace of metallic catalysts and amorphous carbon. In this regard, a sensitive technique for characterization of local impurity in bulk samples of SWNT is desired.

Multiplex coherent anti-Stokes Raman spectroscopy (MCARS) [1] was used to construct an impurity map in a distribution of SWNT bundles. The D- over G-band ratio in the SWNT’s vibrational spectrum is simultaneously acquired and used to characterize the local purity in a spin-coated sample. This technique is faster than conventional Raman microscopy, however it requires further data processing called maximum entropy method (MEM) [2]. The acquired data allows the spectrally selective mapping of the scanned region. Therefore, the impurity map is constructed using the ratio D/G bands [3] (Figure 1 (b)). Additionally, information about the SWNT’s dispersion is obtained through a color association using the D- (red) and G-band (green) in figure 1 (a).

Our measurements indicate that the more dispersed SWNT regions are more exposed to the spontaneous oxidation than the inner nanotubes in a dense region. The observed induced defects by spontaneous oxidation are related to the spatial dispersion of nanotubes in a solid distribution.

Besides, the validity of the application of the MEM algorithm to electronically enhanced CARS spectrum is discussed.

Figure 1: D- and G-band images were combined in a (a) color composition and (b) impurity map using the D/G band images ratio.