Electronic levels of differently engineered arrays of Si nanowires

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The defect level characterization of Si NW array thin films is of major importance in view of the role they play as active layers in the architectures of NW array-based devices. This contribution deals with the electrical properties of silicon nanowire (Si NW) arrays obtained by different growth methods from which, expectedly, their properties strongly depend . We will first present DLTS (deep level transient spectroscopy) results relevant to vapor-liquid-solid (VLS) [1] grown Si NWs. Both shallow and deep levels recover bulk characteristics in such a kind of NWs, provided that their diameter is large enough to avoid quantum confinement. The role played by atoms from Au catalyst seed in VLS Si NWs is also reported. Then, we will illustrate DLTS results of MaCE [2] grown Si NW arrays, where three emitting levels have been detected. In addition, the theoretical multiple line peak fitting of their DLTS spectra give the first evidence that the population statistics of trap levels in NWs recovers bulk features. Finally, DLTS data relevant to Si Grass NW array [3] are reported. Differently from the case of VLS and MaCE samples, the low density of Grass NWs has led us to develop a contacting technique to deposit a Schottky barrier over the NWs. This has allowed us to elaborate a procedure for performing DLTS measurements over NW arrays which enables the characterization of the defect levels of these layers under every density condition. This opens the way to the systematic study of the electrical properties of defects in NW arrays in relation on how they affect the NW-based device performance.

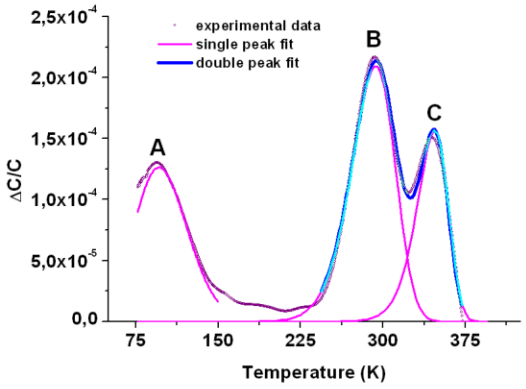

Figure 1 Typical DLTS spectrum of MaCE P-doped Si NWs (emission rate en = 232.6 s−1 , reverse bias Va = −0.5 V, filling bias 0V). The labels identify the electron traps emitting at the peaked positions.

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