Impedance of single-wall carbon nanotubes fibers

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Understanding of charge transport mechanisms in carbon nanotubes arrays is a crucial task for their possible application as a humidity-, gas- and biosensors and as interconnects in integrated circuits. Therefore electrical transport in carbon nanotubes arrays of different morphology has been studied intensively during last decades.

Highly non-linear DC electrical properties of the single-wall carbon nanotubes (SWCNT) fibers were earlier observed [1]. In order to clarify the physical nature of nonlinearity and to determine the role of contact barriers between individual nanotubes in fibers impedance measurements of SWCNT fibers were carried out in the frequency range of $100-10^6$ Hz at temperatures $4.2<T<300$ K and in the range of applied bias voltage 0-5 V. It was found (see Fig.1) that in the low frequency range ($f < 1$ kHz) at the bias voltage $U_b > 2$ V sign of the imaginary part of impedance was changed from negative to positive, in-dicating the existence of the crossover from capacitive reactance to inductive one.

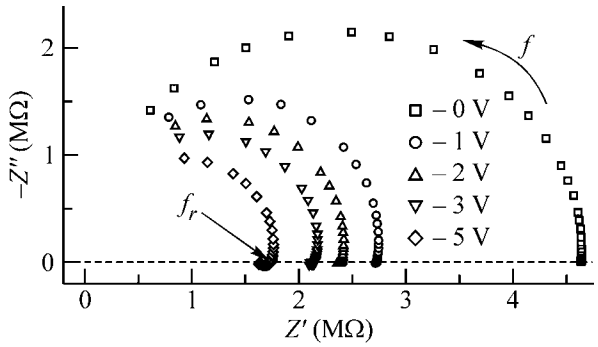

Figure. Impedance diagram of SWCNT fiber measured at T=4.2 K with different applied DC bias voltage.

This crossover is induced by the decreasing of height of the energy barriers between nanotubes at the rising of U_b. As a result decrease of the fiber's impedance is accompanied by the rising of the role of kinetic inductance of nanotubes, which is predicted to be much larger than magnetic inductance [2].

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[2] P.J. Burke, IEEE Trans. *Nanotechnol*. **2**, 55 (2003).