Magnetoresistance of modified by Cobalt Carbon nanotubes

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Aim of work: to investigate the angular dependences of the magnetoresistance of bulk specimens of multiwall carbon nanotubes modified by Cobalt with high mass concentration in a wide temperature range and to establish the mechanisms of magnetoresistance in them.

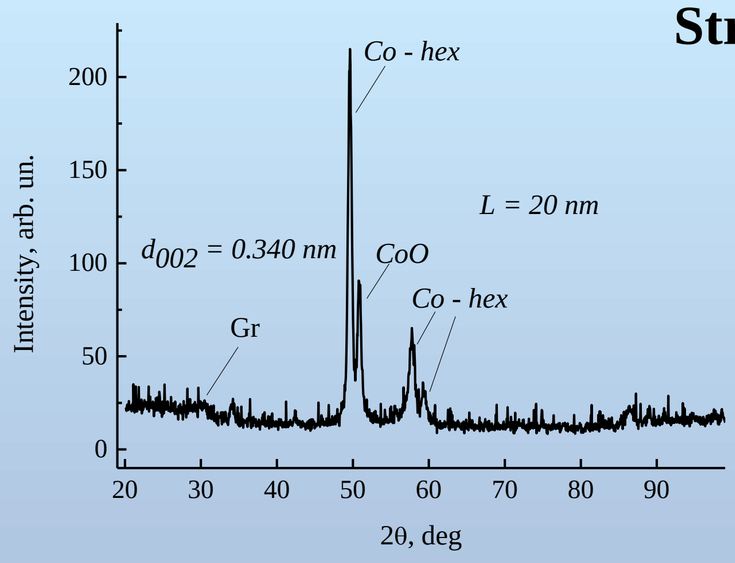
Specimens:

Obtaining of MWCNTs - low temperature conversion of CO in the presence of catalyst.

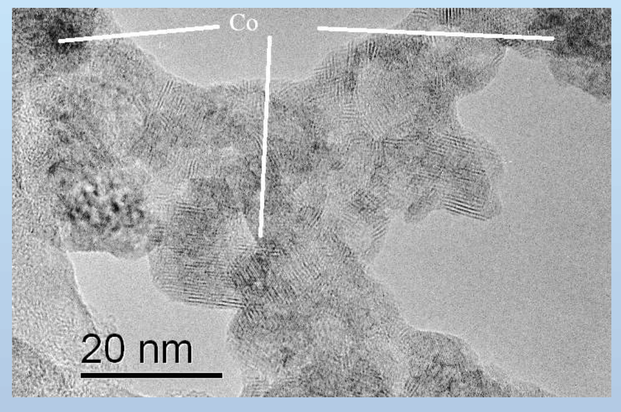
Modification of MWCNTs - reduction of the metal in a stream of hydrogen from a suitable aqueous salt solution.

Bulk specimens of modified MWCNTs - cold compacting of modified nanotubes with PVA as binder (25% mass).

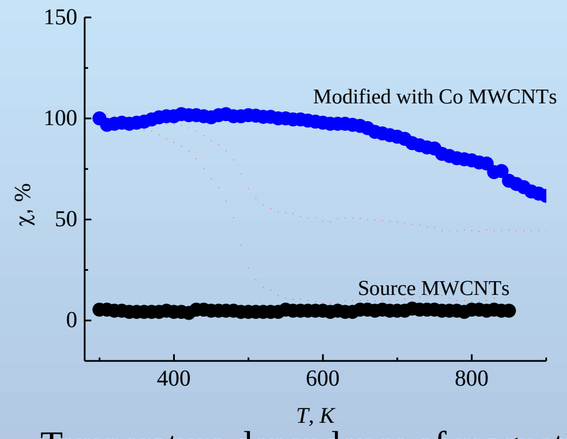
Structure and phase composition of specimens



The fragment of X-ray diffraction pattern of modified MWCNTs



The fragment of HRTEM image for modified MWCNTs

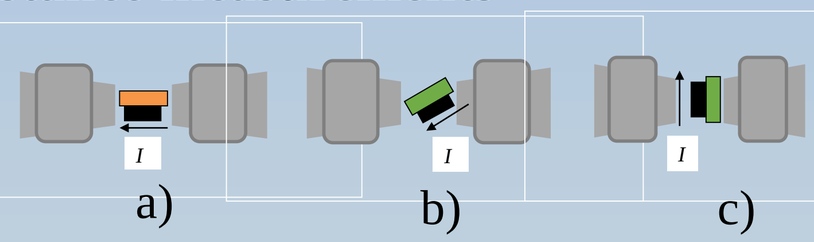


Temperature dependence of magnetic susceptibility $\chi(T)$ for modified MWCNTs

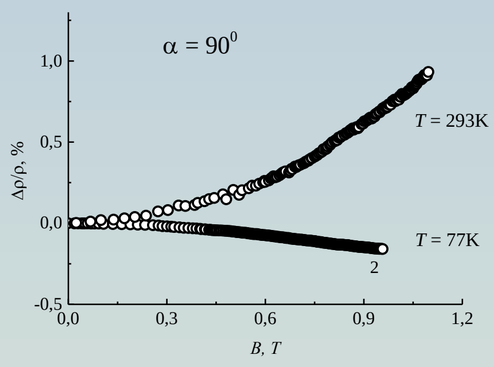
Magnetoresistance measurements

$$\frac{\Delta\rho}{\rho} = \frac{\rho(B)-\rho(0)}{\rho(0)}\,(\%)$$

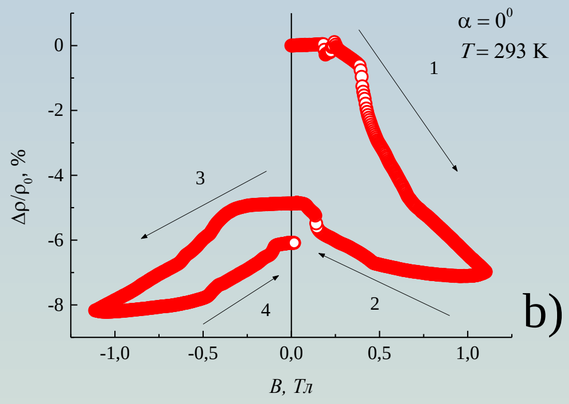
Four-probe DC compensation method in the temperature range from 4.2 K to 293 K and in a magnetic field up to 2 T



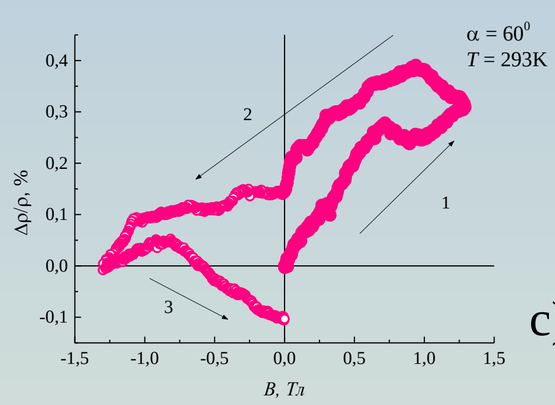
The specimen orientation relative to the magnet, the angle α between the direction of the magnetic field and the direction of current through the specimen: a) (0°), b) (30°), c) (90°). Magnetic resistance measurement error 0.5%



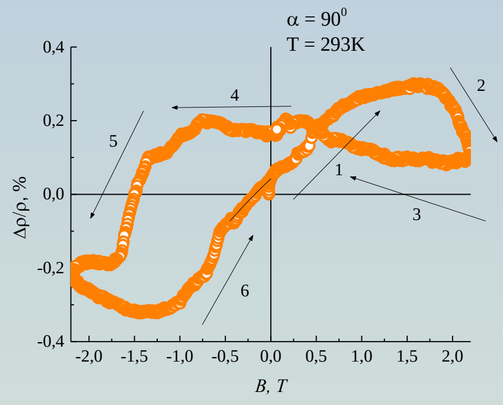
a)



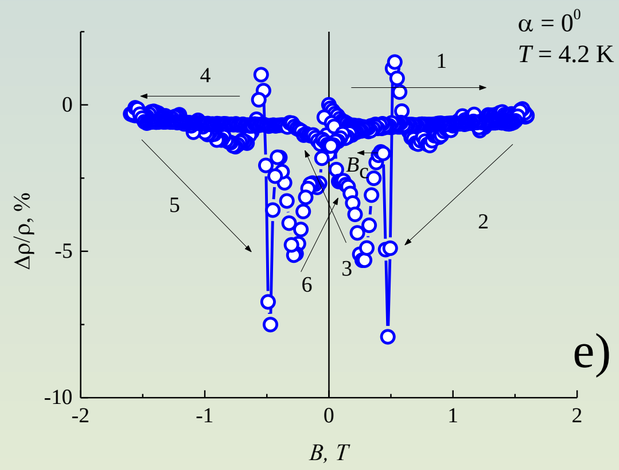
b)



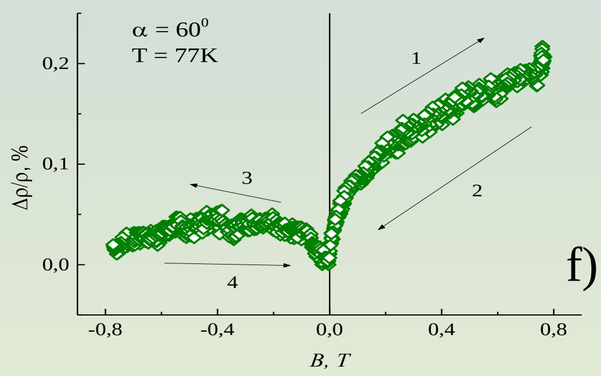
c)



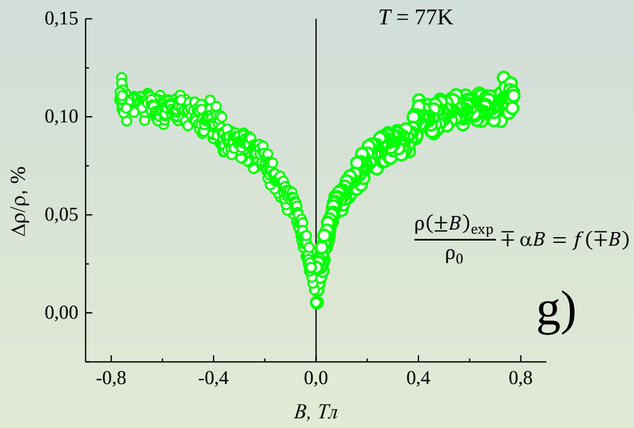
d)



e)



f)



g)

Dependences $\frac{\Delta\rho}{\rho}$ of bulk specimen on modified with Co MWCNTs.
The temperature and angle are shown in the Figures. Arrows and numbers indicate the sequence of measurements.

Conclusions

Magnetoresistance for system MWCNTs – Cobalt is determined by the additive contributions of magnetoresistance of MWCNTs (two-dimensional charge carriers' weak localization (a)), magnetic metal (anisotropic magnetoresistance (c, d)), as well as magnetoresistance associated with the interaction of MWCNTs charge carriers with magnetic moments of ferromagnetic (Co) (b, c, d) and antiferromagnetic (CoO) (e) phases (giant magnetoresistance (b, e) and asymmetric magnetoresistance (c, d, f, g)).