

Structure, properties and possible applications of the films of oriented carbon nanotubes

Alexander Okotrub,¹ Alexey Kudashov,¹
Lyubov Bulusheva,¹ Artem Guselnikov,¹
Anatoly Romanenko¹ and Oleg Abrosimov²

¹Nikolaev Institute of Inorganic Chemistry SB RAS
pr. Ak. Lavrentieva 3
Novosibirsk 630090
Russia

²Boreskov Institute of Catalysis SB RAS
pr. Ak. Lavrentieva 5
Novosibirsk 630090
Russia

The films of aligned carbon nanotubes were prepared by thermolysis of a fullerene C₆₀ and ferrocene mixture on the different type supports. Transmission electron microscopy showed the multiwall tubes are partially filled by iron. The observed angular dependence of X-ray fluorescence from the sample is indicative of well alignment of carbon nanotubes. X-ray photoelectron spectroscopy detected unusually large multiplet splitting of Fe 3s line caused by a reducing of the iron 3d shell. Composite structure of the material resulted in the specific electronic properties. The current-voltage characteristics of the iron-filled nanotubes recorded in a dynamic regime exhibited a hysteresis-like behavior that is likely to be due to tube heating. The film has a high emission current density of about 0.1 mA/mm² at electric field of 1.7 V/mm. The electrical resistance measured along the tubes has semiconductor behavior below 50 and metallic one at the higher temperatures. The films of aligned carbon nanotubes may be used for canalizing of photons and charged particles. The possibility of such application was checked by means of laboratory X-ray fluorescent spectrometer.