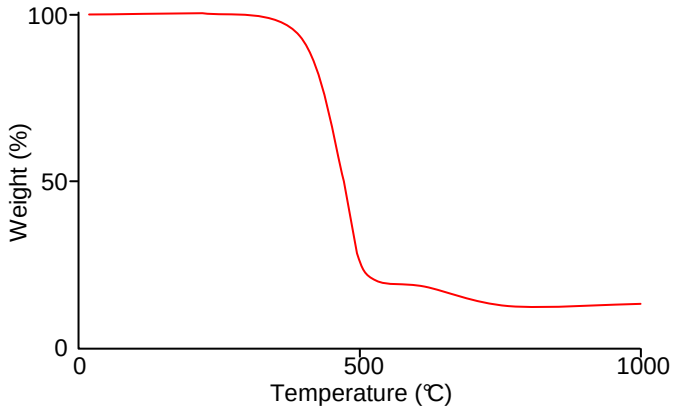
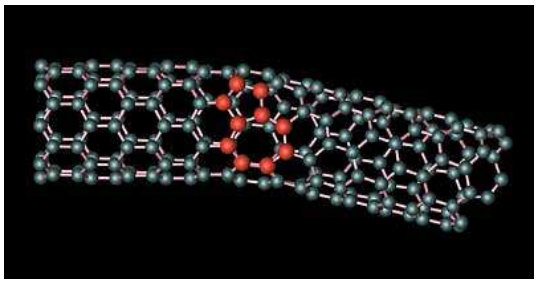
Oxidation behavior of Single-Walled Carbon Nanotubes (SWCNTs)

Reference: Solar synthesis of single-walled carbon nanotubes at medium scale. D. Luxembourg, G. Flamant, D. Laplaze, Carbon 43 (2005) 2302–2310

Introduction: Carbon nanotubes have novel properties that make them potentially useful in a wide variety of applications in nanotechnology. For example, single-walled carbon nanotubes (SWCNTs) exhibit important electric properties, so they are the most likely candidate for miniaturizing electronics. Therefore, many investigations are realized on the production and the behaviour of carbon nanotubes. In this publication, authors showed that the best samples of SWCNTs were produced on the heat exchanger with He as buffer gas and a 15cm long target. Then, thermogravimetric analysis (TGA) was used as a tool to measure the SWCNTs content, the amounts of nontubular carbon impurities and the metal content in SWCNTs samples.



TGA plot of sample He-15cm after purification



A carbon nanotube
(from Wikipedia)

Experimental

The sample was produced on the heat exchanger with He as buffer gas and a 15 cm long target.
After purification by removing metal particles and amorphous carbon, the SWCNT content was estimated from TGA data.
Oxidation tests were carried out in a SETSYS Evolution device using air atmosphere and a heating rate of 3°C.min $^{-1}$.

For more details ask for publication A0582

Instrument
Setsys Evolution TGA (ambient to 1600°C)

Results

A small weight loss (about 10wt%) is observed below 410°C and it can be attributed to the oxidation of amorphous carbon. A second weight loss of about 70wt% is observed for temperatures between 410–520°C and it is attributed to SWCNTs. Then, there is a small weight loss of about 10wt% between 510°C and 800°C, which corresponds to the oxidation of polyaromatic carbon shells. The part of the sample remaining after 800°C oxidation corresponds to oxidized metals.
Since the mass loss during the purification procedure is 50%, TGA results show that the raw sample He-15 cm contains about 35wt% of SWNTs and 10wt% of polyaromatic carbon shells, under the assumption that only fullerenes, amorphous carbon and metal catalysts are eliminated during the purification treatment (No destruction of SWNT). Consequently, these data probably underestimate slightly the SWNT content in the sample.