Nanoauger spectroscopy study of thin film metal catalyst transformation for the production of multi-wall and single-wall carbon nanotubes by chemical method deposition

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The aim of this work is to study in detail the growth process of multi-wall and single-wall carbon nanotubes from thin metal catalyst by using Nanoauger spectroscopy. The growth is performed by CVD using a thin film triple metal (Al/Fe/Mo) catalyst, by a rapid growth process (gas C_2H_2, 1000°C, 5 s) directly on silicon substrates [1]. Recently, a considerable amount of work has been performed using thin film metal layers as the catalyst for nanotube growth, however, the physical phenomena of transforming a thin metal layer into nanosize particles has not been fully understood. We intend to show how the catalyst is transformed and how it diffuses at different growth temperatures [2]. A surface elemental map study is also presented providing a clear view of the distribution of the catalyst on the surface. We observe that during the formation of SWCNT's at high temperatures (~ 1000 ^{o}C), the initial Fe layer (~ 1 nm) is transformed into nano-size particles at the surface. In addition, the Al layer also plays a critical role as a suitable under-layer by being altered into Al_2O_3 particles. Finally, we will show how Nanoauger spectroscopy can also be used to directly observe single-wall carbon nanotubes.

References:

[1] R. G. Lacerda et al., Appl. Phys. Lett. 84, 269 (2004).

[2] R. G. Lacerda et al., J. Appl. Phys. (submitted).