Carbon Nanotubes: Application in Pharmaceuticals

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The discovery of carbon nanotube (CNT) in 1991 by Iijima, gave rise to a new era in material science and nanotechnology [1]. Carbon nanotubes CNTs are allotropes of carbon obtained as single-walled (SWCNTs) or multi-walled (MWCNTs) material with a cylindrical nanostructure. Due to their special and unique electronic and photonic characteristics, such as large specific surface area, wide electrochemical window, flexible surface chemistry, ability to accelerate electronic transfer, these materials became very attractive in many scientific fields from electronics to medicinal chemistry [2].

The evolution in the manufacturing of carbon nanotubes consists an important milestone in modern analytical chemistry. Since the early days analytical chemists have realised the potential of these materials to be used both in analysis and in preparation of samples and they have used them to analyse a wide range of chemical compounds, with pharmaceuticals being among the most important ones [2].

Carbon nanotubes have been mostly used in electroanalytical chemistry. Due to their unique properties, carbon nanotubes have increasingly been used for the construction of electrochemical sensors aiming to improve their analytical response. Some interesting applications include the electrochemical monitoring of piroxicam in different pharmaceutical forms with multi-walled carbon nanotubes paste electrode [3], the high sensitive voltammetric sensor for qualitative and quantitative determination of phenobarbital in pharmaceutical samples [12], the high sensitive voltammetric determination of morphine and diclofenac in biological samples using multiwall carbon nanotubes paste electrode for the simultaneous determination of dopamine and acetaminophen [18], the simultaneous determination of ascorbic acid, dopamine and uric acid by use of a MWCNT modified carbon-ceramic electrode and differential pulse voltammetry [19], the voltammetric biosensors for the determination of paracetamol at carbon nanotube modified pyrolytic graphite electrode [20], the study of the voltammetric behavior of theophylline and its determination at multi-wall carbon nanotube paste electrode [21], the study of the electrocatalytic oxidation and differential pulse voltammetric determination of sulfamethoxazole using carbon nanotube paste electrode [22], the voltammetric determination of bisoprolol fumarate in pharmaceutical formulations and urine using single-wall carbon nanotubes modified glassy carbon electrode [23], the study of the catalytic action of copper (II) ion on electrochemical oxidation of metformine and the voltammetric determination of metformine in pharmaceuticals [24], the voltammetric determination of norepinephrine in the presence of acetaminophen using a novel ionic liquid/multiwall carbon nanotubes paste electrode [25], the novel multi walled carbon nanotubes/p- cyclolextextrin based carbon paste electrode for flow injection potentiometric determination of piroxicam [26], the screen-printed enzymatic biosensor modified with carbon nanotube for the methimazole determination in pharmaceuticals formulations [27] and the number of applications is continuously increasing day by day.

Moreover, CNTs have proposed to be used as innovative pharmaceutical excipients. Two very interesting review articles report on the promising pharmaceutical applications for CNTs as carrier-mediated delivery vehicles for biofunctional molecules, as targets for biophysical treatments, and as templates for tissue regeneration. The possibility of using CNTs as devices for the controlled release of therapeutic agents, using the inner cavities of CNTs for nanochannel fluidic delivery is also promising in pharmaceutical technology [26,27].

Therefore, we can conclude that CNT’s are expected to be used in the future not only in the analysis of pharmaceuticals but in their manufacturing as well.

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Received September 12, 2012; Accepted September 14, 2012; Published September 16, 2012


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