Pharmaceutica Analytica Acta

ISSN: 2153-2435

Samanidou, Pharmaceut Anal Acta 2012, 3:7
DOI: 10.4172/2153-2435.1000e122

Editorial

Open Access

Carbon Nanotubes: Application in Pharmaceuticals

Victoria F. Samanidou*

Laboratory of Analytical Chemistry, Department of Chemistry, Aristotle University of Thessaloniki, 54124 Thessaloniki, Greece

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 as an antiepileptic drug in presence of acetaminophen [4], the voltammetric determination of bisoprolol fumarate in pharmaceutical formulations and urine by using single-wall carbon nanotubes modified glassy carbon electrode [5], the voltammetric determination of cefpirome at multiwalled carbon nanotube modified glassy carbon sensor based electrode in bulk form and pharmaceutical formulation [6].

The electrochemical determination of ascorbic acid and paracetamol in pharmaceutical formulations using a glassy carbon electrode modified with multi-wall carbon nanotubes dispersed in polyhistidine [7], the use of modified glassy carbon electrode with multiwall carbon nanotubes as a voltammetric sensor for determination of noscapine in biological and pharmaceutical samples [8], the simultaneous determination of cysteamine and folic acid in pharmaceutical and biological samples by using modified multiwall carbon nanotube paste electrode [9], the sensitive electrochemical determination of acetaminophen in pharmaceutical formulations at multiwalled carbon nanotube-alumina-coated silica nanocomposite modified electrode [10], the differential pulse voltammetric determination of ciprofibrate in pharmaceutical formulations using a glassy carbon electrode modified with functionalized carbon nanotubes within a poly(allylamine hydrochloride) film [11], the application of modified multiwall carbon nanotubes paste electrode for the simultaneous voltammetric determination of morphine and diclofenac in biological and pharmaceutical samples [12], the high sensitive voltammetric sensor for qualitative and quantitative determination of phenobarbital as an antiepileptic drug in presence of acetaminophen [13], the sensitive voltammetric sensor for determination of synthetic corticosteroid triamcinolone, abused for doping [14].

The highly sensitive voltammetric determination of lamotrigine at highly oriented pyrolytic graphite electrode [15], the determination of amiloride at Nafion–CNT-nano-composite film sensor employing adsorptive stripping differential pulse voltammetry [16], the electrochemical detection of acetaminophen on the functionalized MWCNTs modified electrode using layer-by-layer technique [17], the nanostructure-based electrochemical sensor for 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/β-cyclodextrin 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 continousloy 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.

***Corresponding author:** Victoria Samanidou, Laboratory of Analytical Chemistry, Department of Chemistry, Aristotle University of Thessaloniki, 54124 Thessaloniki, Greece, Tel: +30231997698; Fax: +302310997719; E-mail: samanidu@chem.auth.gr

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

Citation: Samanidou VF (2012) Carbon Nanotubes: Application in Pharmaceuticals. Pharmaceut Anal Acta 3:e122. doi:10.4172/2153-2435.1000e122

References

1. Iijima S (1991) Helical microtubules of graphitic carbon. Nature 354: 56-58.
2. Samanidou V, Karageorgou E (2012) Carbon nanotubes in sample preparation. Curr Org Chem 16: 1645-1669.
3. Abbaspour A, Mirzajani R (2007) Electrochemical monitoring of piroxicam in different pharmaceutical forms with multi-walled carbon nanotubes paste electrode. J Pharm Biomed Anal 44: 41-48.
4. Raoof JB, Baghayeri M, Ojani R (2012) A high sensitive voltammetric sensor for qualitative and quantitative determination of phenobarbital as an antiepileptic drug in presence of acetaminophen. Colloids Surf B Biointerfaces 95: 121-128.
5. Goyal RN, Tyagi A., Bachheti N, Bishnoi S (2008) Voltammetric determination of bisoprolol fumarate in pharmaceutical formulations and urine using single-wall carbon nanotubes modified glassy carbon electrode. Electrochimica Acta 53: 2802-2808.
6. Jain R, Vikas (2011) Voltammetric determination of cefpirome at multiwalled carbon nanotube modified glassy carbon sensor based electrode in bulk form and pharmaceutical formulation. Colloids Surf B Biointerfaces 87: 423-426.
7. Dalmasso PR, María L. Pedano ML, Rivas GA (2012) Electrochemical determination of ascorbic acid and paracetamol in pharmaceutical formulations using a glassy carbon electrode modified with multi-wall carbon nanotubes dispersed in polyhistidine Sens. Actuators B: Chemical, In Press.
8. Rezaei B, Zare SZM (2008) Modified glassy carbon electrode with multiwall carbon nanotubes as a voltammetric sensor for determination of noscapine in biological and pharmaceutical samples. Sens Actuators B Chemical 134: 292-299.
9. Taherkhani A, Karimi-Maleh H, Ensafi AA, Beitollahi H, Hosseini A, et al. (2012) Simultaneous determination of cysteamine and folic acid in pharmaceutical and biological samples using modified multiwall carbon nanotube paste electrode. Chin Chem Lett 23: 237-240.
10. Lu TL,Tsai YC (2011) Sensitive electrochemical determination of acetaminophen in pharmaceutical formulations at multiwalled carbon nanotube-alumina-coated silica nanocomposite modified electrode. Sens Actuators B Chemical1 53: 439-444.
11. Takeda HH, Janegitz BC, Medeiros RA, Mattoso LHC, Fatibello-Filho O (2012) Differential pulse voltammetric determination of ciprofibrate in pharmaceutical formulations using a glassy carbon electrode modified with functionalized carbon nanotubes within a poly(allylamine hydrochloride) film. Sens Actuators B Chemical 161: 755-760.
12. Mokhtari A, Karimi-Maleh H, Ensafi AA, Beitollahi H (2012) Application of modified multiwall carbon nanotubes paste electrode for simultaneous voltammetric determination of morphine and diclofenac in biological and pharmaceutical samples. Sens Actuators B Chemical 169 : 96-100.
13. Goyal RN, Gupta VK, Chatterjee S (2009) A sensitive voltammetric sensor for determination of synthetic corticosteroid triamcinolone, abused for doping. Biosens Bioelectron 24: 3562-3568.
14. Saberi RS, Shahrokhian S (2012) Highly sensitive voltammetric determination of lamotrigine at highly oriented pyrolytic graphite electrode. Bioelectrochemistry 84: 38-43.
15. Desai PB, Srivastava AK (2012) Determination of amiloride at Nafion–CNT-nano-composite film sensor employing adsorptive stripping differential pulse voltammetry. Sens Actuators B Chemical 169: 341-348.
16. Manjunatha R, Nagaraju DH, Suresh GS, Melo JS, D'Souza SF, et al. (2011) Electrochemical detection of acetaminophen on the functionalized MWCNTs modified electrode using layer-by-layer technique. Electrochimica Acta 56: 6619-6627.
17. Beitollahi H, Sheikhshoaie I (2012) Novel nanostructure-based electrochemical sensor for simultaneous determination of dopamine and acetaminophen. Materials Sci Engin C 32: 375-380.
18. Habibi B, Pournaghi-Azar MH (2010) Simultaneous determination of ascorbic acid, dopamine and uric acid by use of a MWCNT modified carbon-ceramic electrode and differential pulse voltammetry. Electrochimica Acta 55: 5492-5498.
19. Goyal RN, Gupta VK, Chatterjee S (2010) Voltammetric biosensors for the determination of paracetamol at carbon nanotube modified pyrolytic graphite electrode. Sens Actuators B Chemical 149: 252-258.
20. Malode SJ, Shetti NP, Nandibewoor ST (2012) Voltammetric behavior of theophylline and its determination at multi-wall carbon nanotube paste electrode. Colloids Surf B Biointerfaces 97: 1-6.
21. Arvand M, Ansari R, Heydari L (2011) Electrocatalytic oxidation and differential pulse voltammetric determination of sulfamethoxazole using carbon nanotube paste electrode. Materials Sci Engin C 3: 1819-1825.
22. Tian XJ, Song JF (2007) Catalytic action of copper (II) ion on electrochemical oxidation of metformine and voltammetric determination of metformine in pharmaceuticals. J Pharma Biomed Anal 44: 1192-1196.
23. Sadegh S, Toktam T, Ali P, Mohammad AK, Ali AE, et al. (2012) Voltammetric determination of norepinephrine in the presence of acetaminophen using a novel ionic liquid/multiwall carbon nanotubes paste electrode. Materials Science and Engineering: C 32: 1912-1918.
24. Khaled E, Kamel MS, Hassan HNA, Haroun AA, Youssef AM, et al. (2012) Novel multi walled carbon nanotubes/β-cyclodextrin based carbon paste electrode for flow injection potentiometric determination of piroxicam. Talanta 97: 96-102.
25. Martinez NA, Messina GA, Bertolino FA, Salinas E, Raba J (2008) Screen-printed enzymatic biosensor modified with carbon nanotube for the methimazole determination in pharmaceuticals formulations. Sensors and Actuators B Chemical 133: 256-262.
26. Foldvari M, Bagonluri M (2008) Carbon nanotubes as functional excipients for nanomedicines: I. pharmaceutical properties. Nanomedicine 4: 173-182.
27. Foldvari M, Bagonluri M (2008) Carbon nanotubes as functional excipients for nanomedicines: II. Drug delivery and biocompatibility issues. Nanomedicine 4: 183-200.