Euro Analytica 2020 : Applications of core–shell particles in active pharmaceutical ingredients via liquid chromatography - Malik Qaisar Hussain - Validation for Pharma Services.

Abstract:

Applications of core–shell particles in active pharmaceutical ingredients via liquid chromatography Malik Qaisar Hussain Director Validation Pharma Services, Lahore, Pakistan Abstract High performance liquid chromatography (HPLC) and ultrahigh performance liquid chromatography (UHPLC or UPLC) have been the most widely used tools for research and routine quality control of active pharmaceutical ingredients (API). The most important challenge in these techniques is fast and efficient separation. Both techniques are preferred due to their selectivity, high accuracy and remarkable precision. On the other hand, they have some limitations: In some cases, traditional HPLC uses high amounts of organic solvents with longer analysis time, and furthermore UHPLC has high back pressure and frictional heating. To overcome these limitations, scientists have developed new type of column particles. In general, two different silica types of column packing material based on their backbone have been used for HPLC and UHPLC. Stationary phases that have fully porous silica particles comply with the essential criteria of analysis, but these show all the limitations of HPLC. However, in recent years, core–shell silica particles (a combination of solid core and porous shell) have been increasingly used for highly efficient separation with reduced run times. Thus, core–shell technology provides the same efficient separations as the sub 2 µm particles that are used in UHPLC, while eliminating the disadvantages (potentially lower backpressure). The key factors for core–shell particles are size and thickness of porous shell layer, the latter of which can be explained using the Van Deemter equation. The columns packed with core–shell particles have been employed in a wide range of applications for analysis and quality control of pharmaceutical active substances.Core-shell nanostructure represents a unique system for applications in electrochemical energy storage devices. Owing to the unique characteristics featuring high power delivery and long-term cycling stability, electrochemical capacitors (ECs) have emerged as one of the most attractive electrochemical storage systems since they can complement or even replace batteries in the energy storage field, especially when high power delivery or uptake is needed. This review aims to summarize recent progress on core-shell nanostructures for advanced supercapacitor applications in view of their hierarchical architecture which not only create the desired hierarchical porous channels, but also possess higher electrical conductivity and better structural mechanical stability. The core-shell nanostructures include carbon/carbon, carbon/metal oxide, carbon/conducting polymer, metal oxide/metal oxide, metal oxide/conducting polymer, conducting polymer/conducting polymer, and even more complex ternary core-shell nanoparticles. The preparation strategies, electrochemical performances, and structural stabilities of core-shell materials for ECs are summarized. The relationship between core-shell nanostructure and electrochemical performance is discussed in detail. In addition, the challenges and new trends in core-shell nanomaterials development have also been proposed.

A copper nanowire-graphene (CuNW-G)core-shell nanostructure was successfully synthesized using a low-temperature plasma-enhanced chemical vapor deposition process at temperatures as low as 400 Â°C for the first time. The CuNW-G core-shell nanostructure was systematically characterized by scanning electron microscopy, transmission electron microscopy, X-ray diffraction, Raman, and X-ray photoelectron spectroscopy measurements. A transparent conducting electrode (TCE) based on the CuNW-G core-shell nanostructure exhibited excellent optical and electrical properties compared to a conventional indium tin oxide TCE. Moreover,

Malik Qaisar Hussain - Validation for Pharma Services, Lahore, Pakisthan
Email ID: pharmaserviceslahore@gmail.com

it showed remarkable thermal oxidation and chemical stability because of the tight encapsulation of the CuNW with gas-impermeable graphene shells. The potential suitability of CuNW-G TCE was demonstrated by fabricating bulk heterojunction polymer solar cells. We anticipate that the CuNW-G core-shell nanostructure can be used as an alternative to conventional TCE materials for emerging optoelectronic devices such as flexible solar cells, displays, and touch panels.Graphitized carbon-encapsulated palladium (Pd) core-shell nanospheres were produced via pulsed laser ablation of a solid Pd foil target submerged in acetonitrile. The microstructural features and optical properties of these nanospheres were characterized via high resolution transmission electron microscopy (HRTEM), X-ray diffraction (XRD), X-ray photoelectron spectroscopy (XPS), and UV-visible spectroscopy. Microstructural analysis indicated that the core-shell nanostructures consisted of single-crystalline cubic metallic Pd spheres that serve as the core material, over which graphitized carbon was anchored as a heterogeneous shell. The absorbance spectrum of the synthesized nanostructures exhibited a broad (absorption) band at â¯¼264 nm; this band corresponded to the typical inter-band transition of a metallic system and resulted possibly from the absorbance of the ionic Pd2+. The catalytic properties of the Pd and Pd@C core-shell nanostructures were investigated using the reduction of nitrobenzene to aniline by an excess amount of NaBH4 in an aqueous solution at room temperature, as a model reaction. Owing to the graphitized carbon-layered structure and the high specific surface area, the resulting Pd@C nanostructures exhibited higher conversion efficiencies than their bare Pd counterparts. In fact, the layered structure provided access to the surface of the Pd nanostructures for the hydrogenation reaction, owing to the synergistic effect between graphitized carbon and the nanostructures. Their unique structure and excellent catalytic performance render Pd@C core-shell nanostructures highly promising candidates for catalysis applications.

This work is partly presenting at 10th World congress on Mass Spectrometry and Analytical Techniques on December 07-08,2020 held at Paris,France