An optimized methodology to analyze biopolymer capsules by environmental scanning electron microscopy

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Abstract

We present an optimal approach for studying the surface properties and interior structure of biopolymer capsules using Scanning Electron Microscopy (SEM) in environmental mode. During studies, a water vapour pressure of 1.3–2.0 mbar is supplied into the SEM specimen chamber to increase the capsule surface's electrical and thermal conductivity and protect it from harm. The fundamental benefit of this procedure is that it requires no preparation and, more importantly, no metallic coating is formed on the specimen's surface, keeping its natural form. It prevents the introduction of preparation artefacts that might alter the capsule's surface and shape, as well as masking information on critical features like as porosities, roughness, coating continuity, and fissures. In addition, chemical contrast is retained in Backscattered Electron (BSE) pictures of unprepared samples, allowing for visualisation of the capsule's internal structure, envelope quality, and so on. Secondary electrons (SE) pictures illustrate the surface shape of uncovered capsules made of an inorganic salt. The coating permeability and coating-core interactions may be evaluated using BSE images of the same salt coated with 10% type A gelatin. This information was also acquired from a study in which hydrogenated vegetable oil was used to wrap capsules containing the same salt. Fine features of gelatin and, in particular, fatty coatings may be seen, which are difficult to study using typical SEM methods. Environmental Energy Dispersive Spectroscopy (EDS) studies have been successfully done to obtain the relative concentration C/O for several simple fatty compounds, such as stearic acids. Finally, this technique allows for a reliable assessment of the parameters employed in capsule development for research and industrial applications, as well as capsule functionality, which is critical for technological advancement in this field. Although there is no formal definition, nanomaterials are materials with at least one dimension of less than 100 nanometers. Nanofilms and coatings (100 nanometers in one dimension), nanotubes and wires (100 nanometers in two dimensions), and nanoparticles (100 nanometers in three dimensions) are among them. Nanoparticles can be found in nature, created inadvertently, or purposefully made. The focus of this review will be on nanoparticles that have been created or created (ENPs). Nanoparticles have distinct physico-chemical characteristics than the bulk substance they come from because of their size. Changes in optical characteristics can affect colour, thermal behaviour, material strength, solubility, conductivity, and (photo) catalytic activity, among other things. Nanoparticles function as a connection between atomic or molecular structures and bulk materials. Nanoparticles formed of semiconducting materials with a size of between 1 and 10 nm, for example, are tiny enough to display quantum effects and are commonly referred to as quantum dots. The shift in surface-to-volume ratio, on the other hand, is probably the most important effect on nanoparticle behaviour. Because the number of atoms at the particle surface grows as the particle size decreases, the surface qualities can override the bulk material's qualities. The potential benefits of tailored nanomaterials have long been known, but the transition from research to manufacturing and utilisation has only lately occurred. Engineered nanomaterials are presently being produced in ever-increasing amounts and are being used in a broad range of products and industries, including pharmaceuticals, cosmetics, apparel, engineering, electronics, and environmental protection. Antibacterial wound dressings and clothes, strengthened tennis rackets, and improved, transparent sun protection are all examples of current use. Nanotechnology-derived food products, additives, supplements, and contact materials are predicted to increase quickly in the food industry. According to Chaudhry et al., approximately 200 businesses are pursuing research and development into the application of nanotechnology in agriculture, engineering, food processing, packaging, and delivery. The development of nano-based detectors, sensors, and labelling might help improve food safety. The rise of nanotechnology has sparked debates over the materials' safety for human health and the environment. Engineered nanoparticles will probably certainly come into contact with people. As a result, it's critical that we learn more about how engineered nanoparticles behave in food, consumer items, and environmental matrices, as well as their toxicity to humans and the environment. To do so, having access to reliable analytical tools for identifying and characterising manufactured nanoparticles in a variety of matrix types is critical. This study gives an overview of the many analytical methods available for detecting and characterising manufactured nanoparticles in product formulations, environmental matrices, and food materials. Because there has been little research on the detection and characterisation of designed nanoparticles in food to far, the review relies mainly on publications that report on nanoparticle characterisation in raw materials and environmental matrices, where substantially more data is accessible. Future directions for ENP characterisation and analysis in biological systems, Samples from the environment or food are recognised, and areas for additional investigation are suggested

Biography

Egle Conforto, an Italian and Brazilian Materials and Biomaterials Scientist, is specialized in Scanning and Transmission Electron Microscopy, which is the red wire of her career. She obtained her BSc degree in Physics and her MSc in Materials Science at Sao Paulo University in Brazil, and worked for 8 years in R&D using electron microscopy. Her PhD degree in materials for nanoelectronics applications was obtained from Ecole Polytechnique Fédérale de Lausanne, Switzerland, where she worked for 10 more years as Head of new projects in biomaterials analyzed by Electron Microscopy. Since 2004 she is the Head of the Electron Microscopy Laboratory at University La Rochelle, being the responsible for its management and for research projects in corrosion and in hydrogen precipitation in Ti and Zr. She is also responsible for the supervisor of master and PhD research works, as well as for undergraduate, graduate and continuing education in electron microscopy.

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