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

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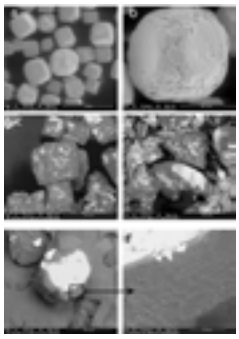
We propose an optimized methodology using Scanning Electron Microscopy (SEM) in environmental mode to study the surface characteristics and the internal structure of biopolymer capsules. Water vapor pressure in the 1.3 – 2.0 mbar range is introduced in the SEM specimen chamber during analyses to improve the electrical and thermal conductivity of the capsule surface, and to preserve it from damage. The main advantage of this methodology is that no preparation is required and, significantly, no metallic coverage is deposited on the surface of the specimen, thus preserving its original morphology. It avoids introducing preparation artefacts which could modify the capsule surface and shape, and mask information concerning important feature like porosities, roughness, coating continuity and cracks. Furthermore, chemical contrast is preserved in Backscattered Electron (BSE) images of unprepared samples, allowing visualizing the internal organization of the capsule, the quality of the envelope etc… Figures 1a and b show the surface morphology of uncovered capsules constituted of an inorganic salt by secondary electrons (SE) images. In Figure 1c and d, BSE images of the same salt coated by 10% of type A gelatin allows evaluating the coating permeability and the coating-core interactions. This information is also obtained from Figs. 1e and f where capsules of the same salt were covered by hydrogenated vegetable oil. We can observe fine details of gelatin and mainly fatty coatings, which are difficult to be analyzed by standard SEM techniques. For some simple fatty molecules like stearic acids for instance, environmental Energy Dispersive Spectroscopy (EDS) analyses have been successfully performed to obtain the relative concentration C/O. Finally, this methodology provides a reliable evaluation of the parameters used in capsule elaboration for research and industrial applications, as well as that of capsule functionality which is essential for the technological progress in this domain.



SEM images in environmental mode of capsules of an inorganic salt; a) and b) SE images of uncovered capsules;BSE images of the same capsules covered with: gelatin (c, d); and fat (e, f).

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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