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Dr. Alejandra Camacho Bragado

Senior Research Scientist at L'Oreal Cosmetics

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When imperfect sample meets results rush. Industrial applications of *in-situ* scanning electron microscopy

Advances in microelectronics, electron sources, data storage and sample preparation equipment have speed up the development of modern election microscopy. Improvements have been made in resolution and contrast detection that allow us to resolve details that were invisible in the past. In conjunction with higher resolution, modern microscopes allow the combination and integration of additional detectors, sample holders and instruments to manipulate the specimen and its environment and observe phenomena in real time. The observation of undisturbed samples and specimens in the native state have helped advances in Biology and other areas. In industrial applications, development of these techniques has meant faster detection and response to quality and contamination issues as well as development of new products based on a deeper understanding on how different formulations interact with the target substrates. In particular, the discussion will focus on the study of products that are applied to the hair or skin to fulfill a therapeutic or cosmetic function. The design of products for cutaneous application requires an understanding of the interaction of the formula or a particular ingredient with the substrate (i.e. the stratum corneum). Some important parameters to understand about topical formulations include surface coverage, drying rate and durability; interactions that may modify efficacy of topical formulae are those with body fluids such as sweat and changes induced by temperature fluctuations. This combination of active substrate and dynamic conditions can impose challenges in the achievement of a particular cosmetic or therapeutic effect and call for a detailed analysis of the different interactions. Two areas of analyses are to be considered:

1. the study of the interaction of the substrate with individual ingredients, whether they are considered actives, excipients or others that regulate the delivery of the actives.
2. the behavior of new ingredients in a formulation.

This presentation will include a series of cases in which the environmental scanning electron microscope (ESEM) was used to understand ingredient performance through *in-situ* dynamic experiments. These case studies include the characterization of excipients in contact with water and sweat, film formation

Department Contact Information
Dr. Miguel Jose-Yacaman
Miguel.yacaman@utsa.edu
Christella Robledo
Christella.Robledo@utsa.edu
http://physics.utsa.edu