EXPLORING THE LOCAL PROPERTIES OF THE COSMETIC SUBSTRATE (HAIR AND SKIN) BY SCANNING NANOPROBES

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Traditionally the use of Scanning Electron Microscopy (SEM) and Transmission Electron Microscopy is essential to understand the complex structure of cosmetic substrates: hair and skin. With the advent of Atomic Force Microscopy (AFM) and Nanoindentation it has become possible to understand local mechanical properties of these "biocomposites" at nano-level.

We will present a review of our knowledge of the complex structure of skin and hair, emphasizing those aspects of special interest for its lasting and protection. At the surface, we have been most interested in the friction (nano-tribology) of hair fibers based on the properties of covalently linked fatty acids (i.e. 18-methyleicosanoic acid) that are part of its original natural structure, as well as the subtle modifications induced by water and other standard cosmetic treatments. By using AFM in combination with Nanoindentation our current understanding on the nano-mechanics (modulus, hardness) of substrates is also improved. Of special interest is to localize the contribution of hair and skin constituents to the overall macroscopic structure. We measured the mechanical properties of hair and stratum corneum at different humidity. In hair a comparison with results obtained on surface transversal cuts was also done. Both hardness values and Young's modulus changes clearly show the complex structure of the hair. Cuticle behavior is different from cortex behavior. A gradient of mechanical properties (hardness and Young's modulus) depending on indentation plastic depth is observed. Changes as a function of humidity have been measured on the loss factor evolution.

Physicochemical local information can be obtained from the use of chemically modified AFM tips. We will present adhesion results using chemically-modified probes (Chemical Force Microscopy) as a way to quantify their chemical interaction on the hair surface. The results show that ionized chemical groups of the surface are present. A discussion, based on the surface models widely accepted for hair structure, will be presented.

Combination of these high resolution techniques helps us to advance towards the identification of the role and properties of hair components such as lipids and proteins, and therefore, localize and evaluate the effects of a specific cosmetic treatment.

References:

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