A closer look at the Skin's Surface Nanostructure and Barrier Function in Cosmetics

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The skin's outermost layer, the stratum corneum, plays a critical role in maintaining barrier function and regulating interactions with cosmetic formulations. Recent advances in nanoscale imaging have opened new avenues for understanding its complex morphology and mechanical behavior. Among these, Atomic Force Microscopy (AFM) stands out as a powerful tool for characterizing the skin surface with nanometric precision, both in vitro and ex vivo. By leveraging the physical interaction of a nanoscale probe, AFM provides not only topographical resolution but also insights into the mechanical and chemical properties of the skin.

This presentation explores the application of AFM in cosmetic science, highlighting its ability to reveal the structural and functional nuances of the skin barrier. We will discuss a series of recent studies that demonstrate how AFM contributes to the development and evaluation of cosmetic technologies:

Poroelastic Behavior and Water Permeability: Investigations into the skin's poroelastic properties at the nanoscale provided new understanding of hydration dynamics and barrier permeability.

Biomimetic UV Protection: Structured epicuticular wax films were shown to mimic natural photoprotective mechanisms, with AFM elucidating their surface architecture and protective function.

Distribution of Active Compounds: Mass spectroscopy Tof SIMMS mapped the spatial partitioning of cosmetic actives between corneocytes and the lipid matrix, helping formulation strategies.

Mechanical Integrity of the Stratum Corneum: Studies revealed how anisotropic cellular forces contribute to the skin's mechanical resilience, offering insights into barrier reinforcement.

Acrylic Films in Cosmetics: AFM helped decode the structural mechanisms behind high-performing skin coatings, revealing how acrylic polymers interact with the skin surface to enhance durability and aesthetics.

Together, these findings underscore the value of AFM in advancing cosmetic science, enabling precise evaluation of skin interactions and guiding the design of more effective and biomimetic formulations.

References

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