HORIBA
Scientific

The Science of Beauty

Exploring characterization techniques in cosmetics

JOBIN YVON
Technology

Unleashing the potential in diverse domains

The cosmetic industry is a dynamic and rapidly evolving field dedicated to enhancing wellness and self-expression. Innovation drives this industry, with ongoing advancements in formulation, ingredient efficacy, and product safety, along with stringent standards.

The creation of innovative cosmetics products relies on deep scientific knowledge of biological matrices (skin, hair, teeth), and the development of optimized formulations with an instrumental evaluation of their performance.

From the assessment of formulation compositions and their stability to ensure a product efficacy and proper shelf life, to the impact of environmental factors such as UV exposure and air pollution, HORIBA's instruments can help to analyze and develop effective, safe and market compeetitive products !

Uncover the extensive analysis in which HORIBA's products can intervene to elevate the cosmetic field:

In-vivo and *ex-vivo* evaluation
(Raman, Fluorescence)

- Endogenous markers:
  Water, lipids, proteins, natural moisturizing factors
  Tryptophan, porphyrin, collagen, melanin
- Cosmetic devices: Microneedles, patches, blue light
- Penetration of active molecules or nanoparticles
- Surface deposits

Skin knowledge
(Raman, AFM, SPRi, Fluorescence)

- Impact of external factors: Pollution, UV
- Chrono-photo-aging, hydration
- Cell models, reconstructed skin, explants
- Biofilms, lipidic films
- Surface properties: Roughness, adhesion, molecular composition, coatings

Hair chemistry
(Raman, AFM, ICP, Fluorescence)

- Effect of treatments: coloring, shampoos, masks and oils
- Impact of routines: ironing, chemical straightening, bleaching
- Environmental factors: humidity, sun exposure, ozone, metal content
- Hair chemistry: keratin, sebum, melanin, water
- Active penetration: cuticle, cortex, medulla
- Surface functionalization and coatings

Raw materials
(Raman, AFM, ICP, PCA, XRF, Fluorescence)

- Size distribution and zeta potential
- Molecular and elemental composition
- Quality control: Adulteration, origin, impurities, active molecule concentration, REACH
- For small molecules, nanoparticles, polymers, lipids, proteins

Formulation
(Raman, AFM, PCA, SPRi, XRF, Fluorescence)

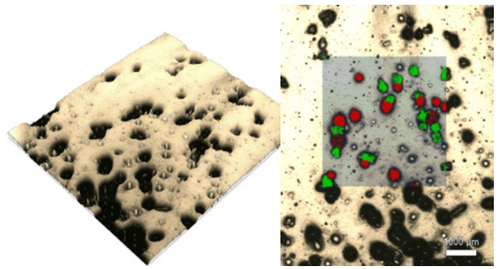
- Spreading, film homogeneity
- Size of domains, particles spatial distribution
- Interaction with packaging, stability
- Micro-nanoemulsions, micelles
- Encapsulation and loading with delivery systems: Liposomes, capsules, microspheres

AFM = Atomic Force Microscopy
PCA = Particle Characterization Analysis
ICP = Inductively Coupled Plasma
XRF = X-ray Fluorescence
SPRi = Surface Plasmon Resonance Imaging

Enchanting possibilities: Propelling key applications

LabRAM Soleil

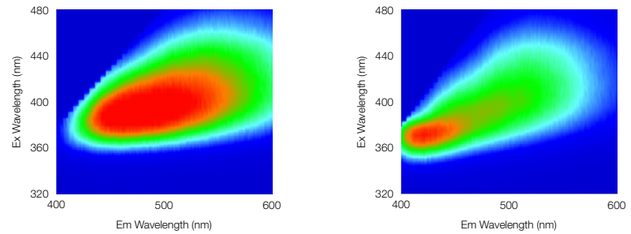
Raman imaging faster than before to support your ingredient selection and skin & hair care formulation development to achieve desired effects and product performance.



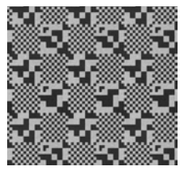
Combined optical and Raman microscopies identify and count different abrasive particles embedded in a commercial charcoal blemish exfoliator, based on their chemical composition.

Duetta

Fluorescence A-TEEM replaces your HPLC workflow for qualification of raw materials by a rapid optical fingerprinting control.

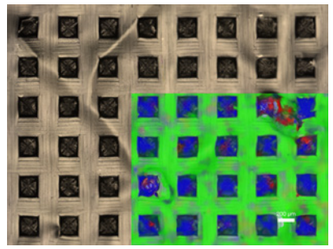


A-TEEM determination of the origin and adulteration of essential oils, in only a few seconds and at low cost.



nanoGPS

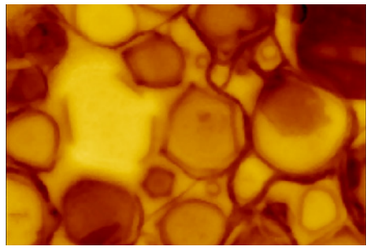
NanoGPS navYX for direct and fast relocalization between different imaging modalities (Raman, µFTIR, SEM…), thus complementing nanoscale observation with chemical characterization.



Microneedles patch designed for acne treatment investigated by SEM / Raman correlative imaging. Evaluation of the needles' active loading or potential initial damage, and dissolution after application on skin.

SignatureSPM

Atomic Force Microscopy (AFM) finally made easy for all, with the bonus of added chemical capabilities on the same spot, for your routine work at the nanoscale.



Direct AFM observation of a microemulsion from an anti-aging cream, in a native hydrated state, obtained without any sample preparation.

A myriad of other opportunities

XGT-9000

Micro-XRF measures elemental quantities, even at the microscopic particle level, and identifies the presence of contaminants. Through mapping analysis, it details the **distribution of elements** in formulation spreadings.

Partica LA-960V2

Laser diffraction analyzers determine the **size distribution** of particulates found in foundations, sunscreens, eye shadows, and creams. Whether analyzing raw materials or formulated products, it provides precise particle size measurements essential for quality and performance.

OpenPleX

SPRi studies can benefit cosmetics research by guiding the formulation optimization process, through the understanding of binding affinity, pharmacokinetics, and the dose-response relationship between an active molecule and its target, to fine-tune ingredient concentrations.

ULTIMA Expert

ICP-OES quantifies metallic traces (Ti, Fe, Zn, Al…) at low concentrations in raw materials, packaging or biological matrices like hair or nails, for performance and safety evaluation (Pb, Hg, Cd, Co…)

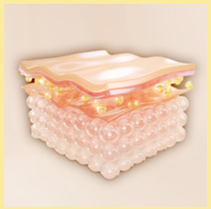
nanoPartica SZ-100V2

Dynamic Light Scattering (DLS) brings, in addition to particle size determination, the **Zeta Potential** to support the development of stable suspensions or emulsions, predicts interactions, and optimizes the formation of films and coatings.

Raman with EDF and HSI

Cytoviva modules (Enhanced Dark Field and Hyperspectral imaging) can be integrated onto a Raman imaging platform. This allows capturing **very large area HSI and EDF** images with high spatial and spectral resolution. Nanoparticles can be easily detected on skin, hair or formulations.

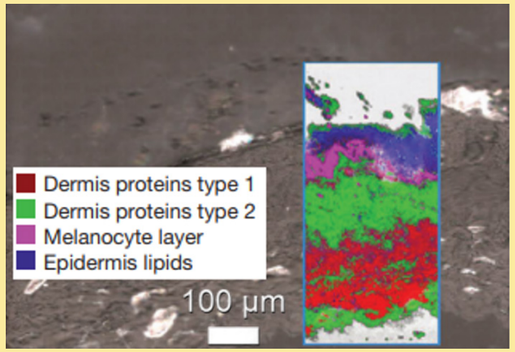
Resolving beauty dilemmas



Exploring the intricacies of skin physiology and unveiling the efficacy of skincare treatments

Decipher mechanisms of action and evaluate the performance of products by analyzing skin components and functions via **Raman molecular spectroscopy**, non-destructively.

Determine concentration and distribution of active ingredients within skin layers, on cross-sections, directly on explants via confocal depth profiling*, or even on reconstructed skin models, to enable the development of highly targeted and effective formulations.



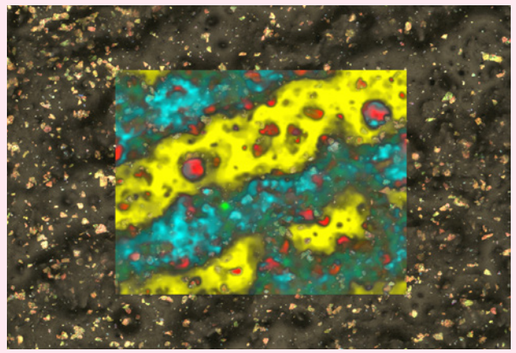
High-resolution multivariate image of a skin cross-section showing the different layers and constituents (skin surface on top). Courtesy of O. Piot, Faculty of Pharmacy, University of Reims Champagne-Ardenne, France.

**Tfaili, S. et al. (2014). Monitoring caffeine and resveratrol cutaneous permeation by confocal Raman microspectroscopy. Journal of Biophotonics, 7(9), 676-681.*

Unveiling the surface secrets: Gaining insight into product-substrate interactions

The introduction of **HORIBA LabRAM Soleil** microscope opens new opportunities in rapid Raman chemical imaging for formulations spreading at macroscopically relevant scales.

Large high-resolution maps can explain films formation, coverage and uniformity, while revealing physicochemical phenomena, like particles aggregation, phase migration, coalescence, evaporation of volatile compounds, or crystallization.

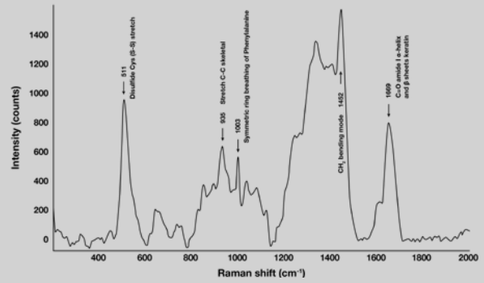


Cream serum with vitamin C and SPF booster, spread over a PMMA plate used for in-vitro sunscreen testing. 1.3 x 1 mm² Raman map with 3D topography acquired in 30 minutes displaying octosalate, tin oxide, dimethicone and silica.

Investigating the molecular signature occurring in greying hair shafts

Raman spectroscopy is widely used to study hair fiber chemistry and evaluate the impact of treatments and environmental factors, usually by looking at damage on the disulfide bond from cysteine residues.

We highlight a study identifying molecular markers altered in the course of greying. Gradual modification of lipid conformation and protein secondary structure, indicate an alteration of the barrier function and biomechanical properties.



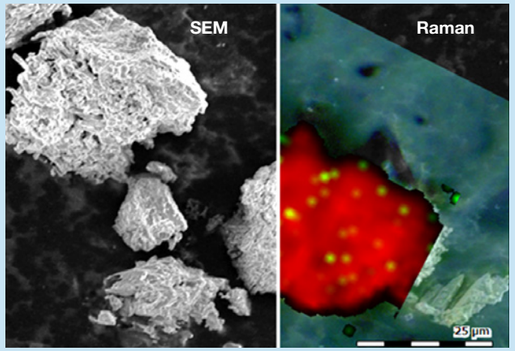
Raman spectrum of a Caucasian natural human grey hair with identification of the main markers in the fingerprint region.

Vyumvuhore, R. et al. (2021). Investigation of the molecular signature of greying hair shafts. International Journal of Cosmetic Science, 43(3), 332-340.

Evaluating ingredients design and performance, while ensuring proper regulatory filling

Electron microscopy remains the technique of choice for direct visualization of submicronic particles but lacks the power of molecular identification.

With **nanoGPS NavYX** to easily automate repositioning between Scanning Electron Microscopy (SEM), used for high-resolution visualization and size measurement, and Raman imaging at the exact same location, a full structural and chemical characterization of nano objects is now possible.



Correlative SEM-Raman microscopy revealing unwanted aggregation of Zinc Oxide (ZnO) particles (used as UV filters and white pigments in sunscreen) into large clusters and the presence of impurities (green dots).

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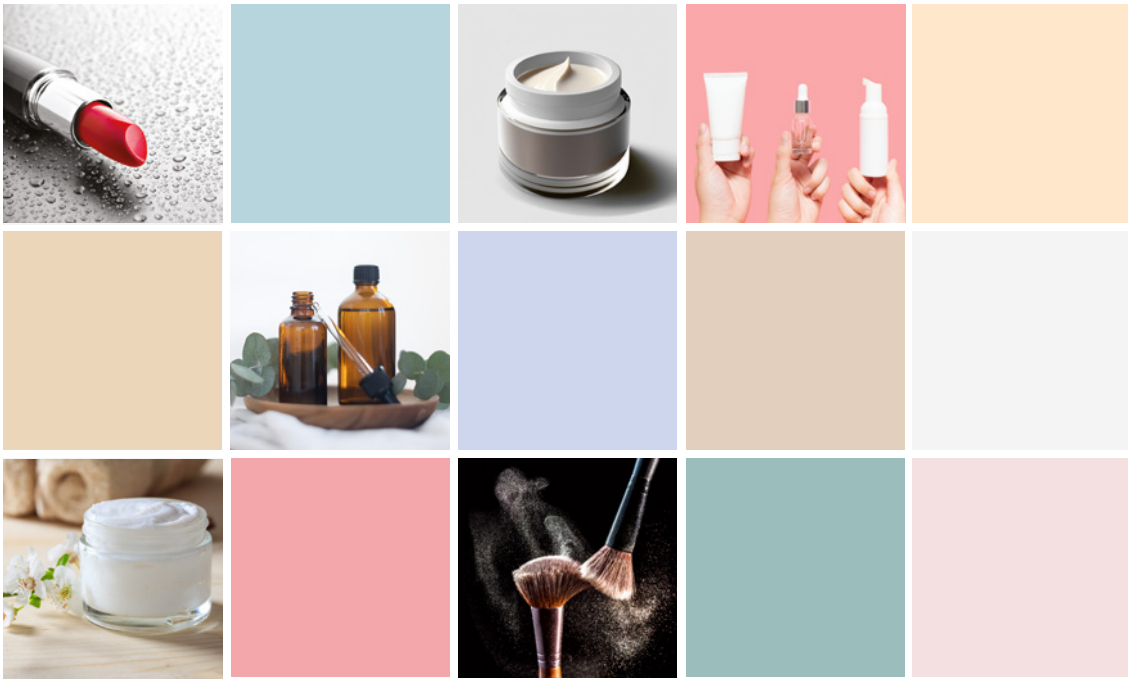

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