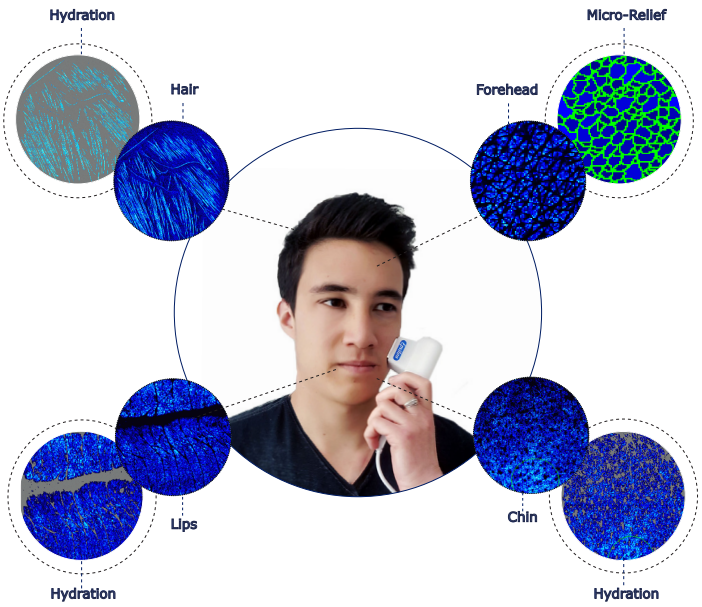
Epsilon

IMAGE + HYDRATION DATA MEASURMENT

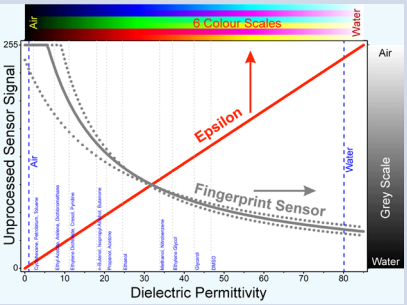


- Imaging + Measurement
- Unique Linear and Calibrated Response
- Hydration Imaging with 256 Levels of Sensitivity
- Image Filtration to Remove Artefacts
- Micro-relief Analysis for Skin Ageing
- Capacitance Measurement Principle
- 50µm Image Resolution,
- ~5µm Depth Resolution 5µm sensing depth
- specifically targets the stratum corneum
- Sensing Area 12.8 x 15mm, 76800 Pixels
- in vitro Accessories

Figure 1: Epsilon Model E100 for in vivo + in vitro **Measurement**

Technology Background

The Epsilon integrated technology provides both image and hydration data simultaneously (suitable for both in vivo + in vitro measurements). It differs from similar devices in its linear and calibrated response. Equipped with 76800 sensors the Epsilon can measure skin hydration with greater accuracy and flexibility than conventional single-sensor probes. By contrast, an otherwise similar contact imaging instrument (MoistureMap Model MM100, CK Technology sprl, Belgium) can only be used to give a qualitative indication of hydration heterogeneity, with the manufacturer recommending that the Corneometer® (Courage + Khazaka GmbH, Germany) be used for measurement.



The Epsilon uses dielectric permittivity (dielectric constant, ε) for calibration. This is because dielectric permittivity is a material property where several solvents and other materials (see Figure 2 for examples), are readily available for use as reliable calibration reference materials. By contrast, capacitance is a device property without independent definition.

Figure 2: Native capacitance response (grey) and calibrated permittivity response (red) of a typical fingerprint sensor.

Artefacts in Hydration Measurement

- **Lines & Wrinkles**
- **Hairy Skin**
- **Curved Surfaces**
- **Insensible Perspiration**

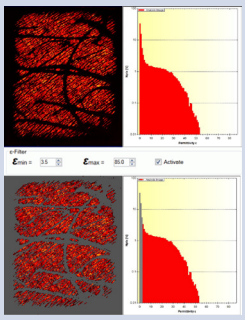


Figure 3: Hairy male ventral forearm, where the bad contact shows up as black, ie low ε of hair and air. The histogram (NB: Log scale) indicates bad contact by the prominent peak at low ε.The ε -filter allows you to remove both low and high ε pixels.This shows the effect of filtering pixels with ε -values below 3.5. Filtered pixels are shown in grey. The ~43% of pixels that remain give more accurate skin hydration information (ε =18.1) than the unfiltered image (ε =8.3).

Characterising Heterogeneity

- **Mean Hydration & Standard Deviation**
- **Region of Interest (RoI) Analysis**

Epsilon images provide a revealing visualisation of hydration distribution in the vicinity of the site of interest. These images can be processed to give quantitative measures of heterogeneity as either Standard Deviation or Coefficient of Variation (CV%), or visually as histograms. This is illustrated with a volar forearm image in Figure 4

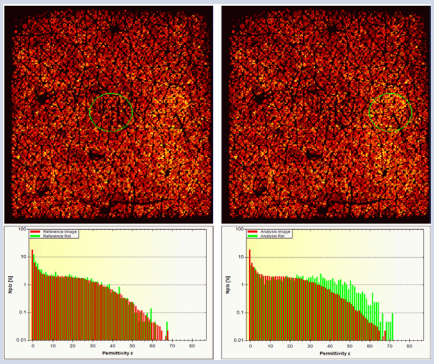
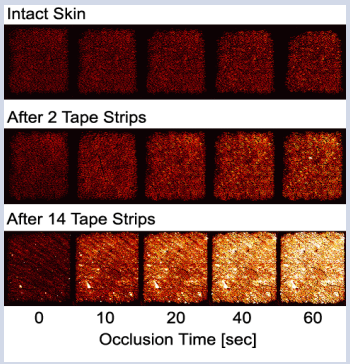


Figure 4: These two images are the same, but with the 2.6mm diameter green Region of Interest (RoI) circle displaced by a horizontal distance of 3.8mm.
The colour-co-ordinated histograms indicate hydration distribution for both the whole image (red) and the RoI (green).

Other Measurement Capabilities

- **Hydration Dynamics**
- **Skin Topology**



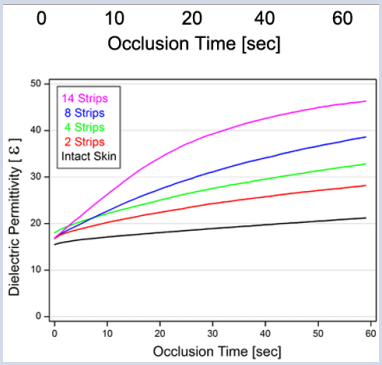


Figure 5: Shown here are example images from the recorded bursts. Significant barrier damage becomes visible after just 2 strips, as indicated by the increased rate of surface water accumulation compared with intact skin. Also, thebarrier damage after 14 strips is highly heterogeneous, with the bright yellow areasindicating greater than average damage. These occlusion plots were calculated as whole-image averages. They clearly show (i) an almost unchanged hydration at t=0, irrespetive of the number of strips removed,and (ii) increased barrier damage with number of strips removed.