

Abstract

In this thesis, the hydration-behaviour of the Stratum Corneum is investigated by electron microscopy. The first chapter provides general theoretical background, for example the formation of the Stratum Corneum and its biological function as a permeation barrier in the skin. Although the electron microscopy of biological samples is established as a common technique for decades, proper interpretation of the images requires further knowledge about the underlying electron-sample-interactions and signal contrast mechanisms. These are also affected by the sample preparation. Thus, the chapter about the biological basics is followed by a chapter about electron microscopy.

A part of this work consists of modifying and improving an existing sample preparation protocol for skin: Instead of chemical fixation, the samples were physically fixed to reliably preserve the inherent water content. For example, freezing in liquid ethane (plunge freezing) makes large cross sections and statistical analysis of the hydration behaviour after topical application of different salt solutions possible. High resolutional images were possible with high pressure frozen samples. Additional investigations were performed after enabling a further penetration pathway by hydrating the Stratum Corneum from the side.

Having adapted the preparation protocol to the specific sample type, it became possible not only to interpret single high resolutional images but also to estimate the biological variation and significance of all data.

The data show a local variation of the hydration behaviour: Cells in the deeper and upper Stratum Corneum (near the outside of the skin) are extremely hydrophilic and their hydration state and thickness in part corresponds directly with the externally applied media. Between these two zones, a zone with very low water uptake and high mechanical stability could be discriminated using samples from the upper arm and from the face. This leads to the hypothesis that the effective hydration barrier of the Stratum Corneum is located in this zone.