Optical Methods of Imaging in the Skin

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The skin is the biggest organ of the body, representing its barrier to the environment. It provides protection against water loss, keeps microorganisms from invading our body, and responds sensitively to external stimuli. The skin barrier is formed by the uppermost cell layer, i.e., the stratum corneum, consisting of dead horny cells. Underlying the stratum corneum are various layers of living cells. The capillary structures of the blood vessels appear from a depth of approximately 150 μm beneath the skin surface. The homogeneous structure of the skin surface is interrupted by hair follicles and sweat glands. As a sensory organ the skin is an essential means of interpersonal communication. This is why we devote particular attention to skin care and dermal treatment. In this context, diagnostics and therapy control play a decisive role. Easily accessible, the skin is an ideal object to be investigated by noninvasive optical and spectroscopic methods. An ample range of such methods is available for dermal analysis, including fluorescence, reflectance, Raman, and CARS measurements. Laser scanning microscopy has proven to be specifically suitable for investigating the skin barrier and the underlying living cell layers up to a depth of 200 μm depending on the wavelength applied, imaging both cellular and molecular structures. The primary purpose of these investigations is to analyze the integrity of the skin barrier, which is characterized by the organization of the cellular structures and by the composition of the lipid layers surrounding the cells. The application both of laser scanning microscopy and optical coherence tomography is focused mainly on the detection of dermal lesions, in particular of skin tumors, and their response to different therapies.

Optical imaging methods are also becoming increasingly popular in the field of pharmacology, specifically for investigating the penetration of topically applied substances into and through the skin barrier.

Due to the rapid development of optical techniques, both in terms of excitation by lasers and light-emitting diodes, and in terms of detection using capacitive sensors, optical and spectroscopic methods are increasingly applied in medicine, cosmetics, and cutaneous physiology. The articles published in this special section provide some impressive examples.


It will also be shown that a single technique suitable for all issues is not available, but that it is necessary to select the optimum technique for the specific purpose.

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