Decontamination of the skin from environmental pollutants

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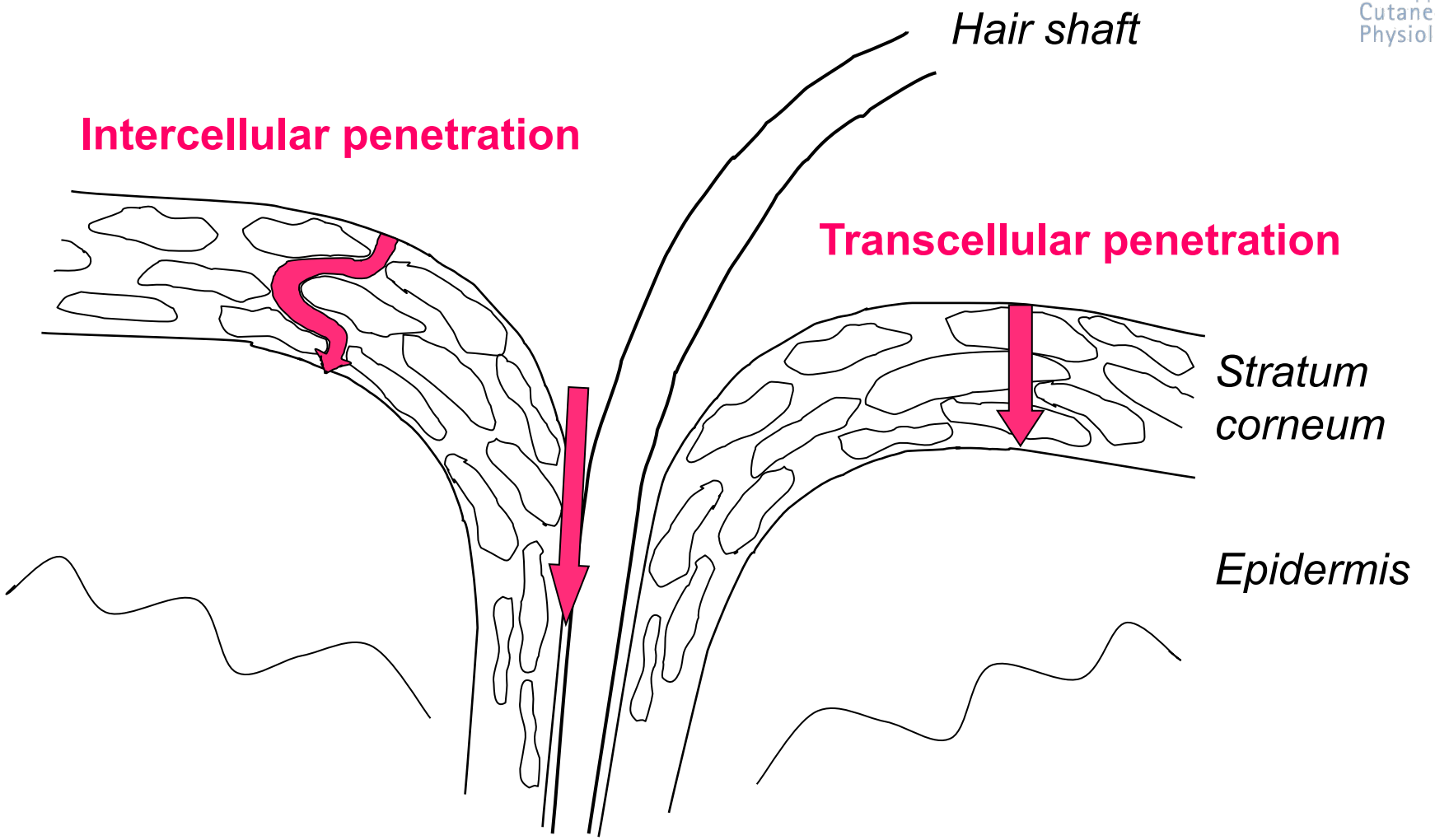
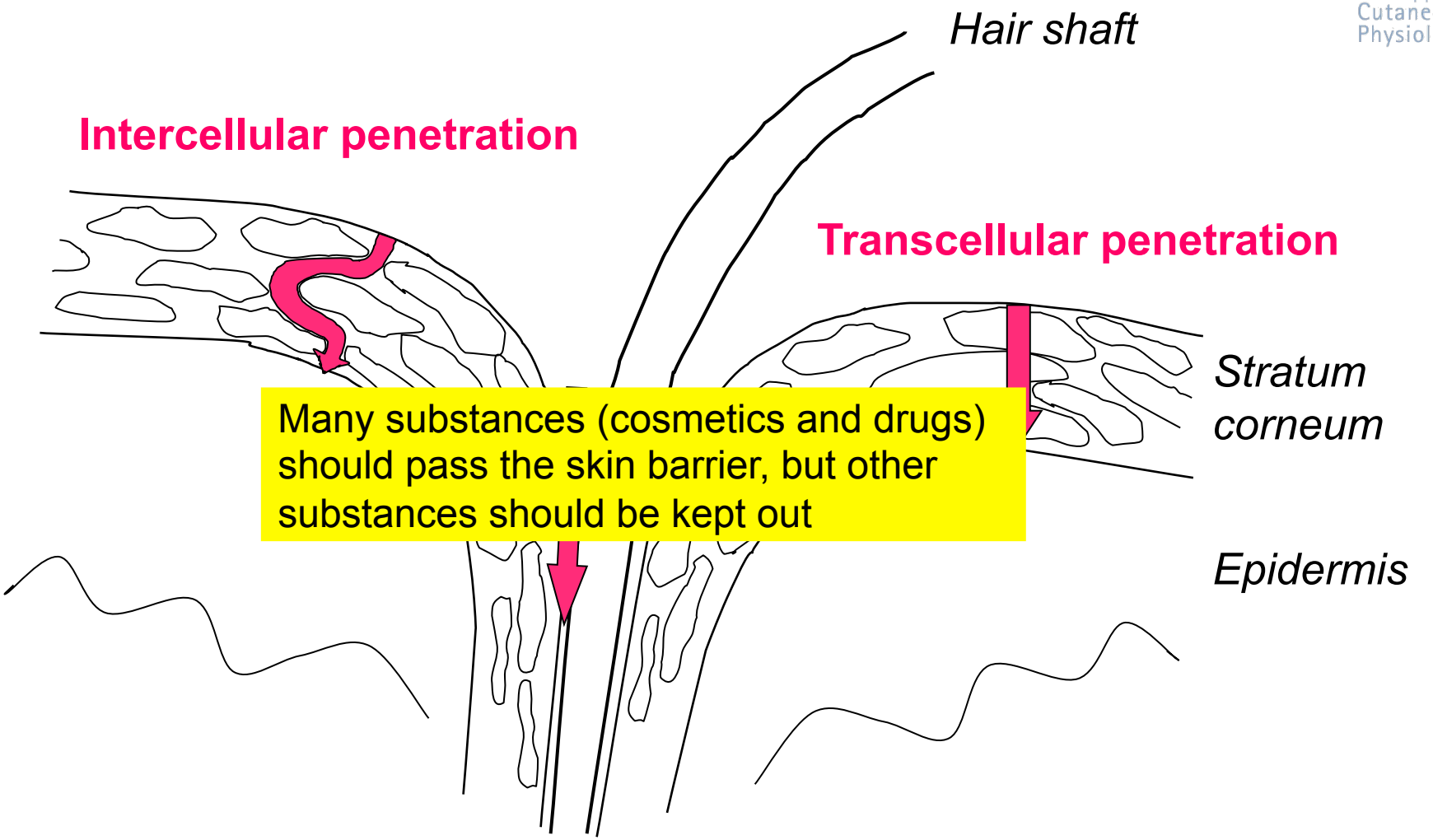
Penetration pathways



Penetration pathways



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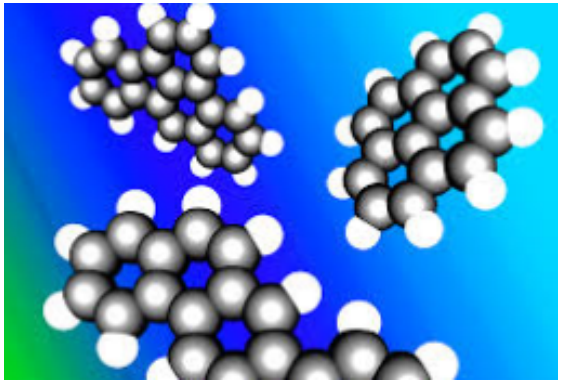
Sooty particles in the air


+

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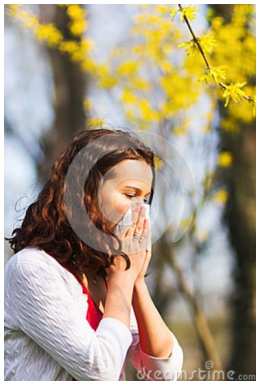

- Exhaust fumes from traffic and industrial production = activated carbon
- Activated carbon adsorbs polycyclic aromatic hydrocarbons and allergens.
- Sooty particles have a size of 50 nm to 100 nm, industrial dust particles can be up to 400 nm in size.
- If the particles come in contact with human skin, the hazardous substances will be released and dermatological diseases will be the consequences.

Release of harmful substances from sooty particles on the skin

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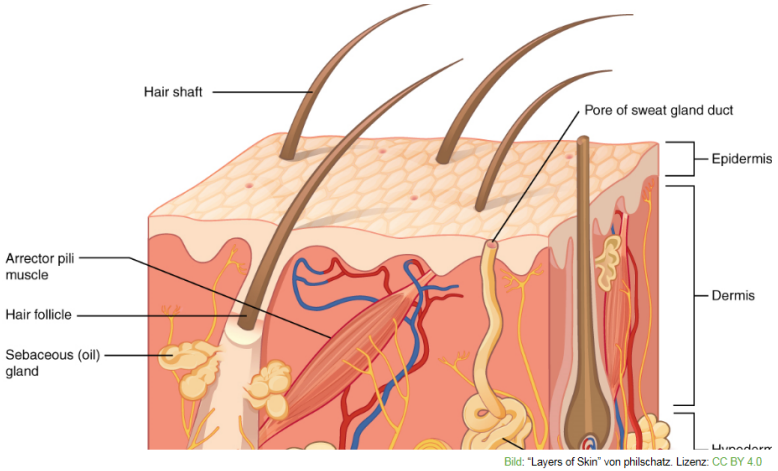
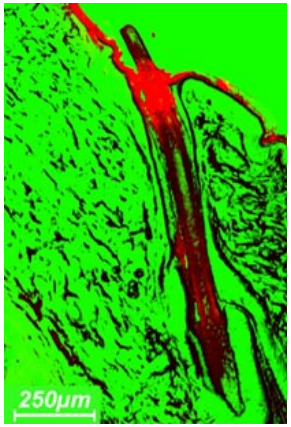
Sooty particles from cars have a diameter from 100nm to 1µm. They prepressed activated carbon and absorb all substances that are flying in the air:

- Pollen allergens
- PAH (polycyclic aromatic hydrocarbons)

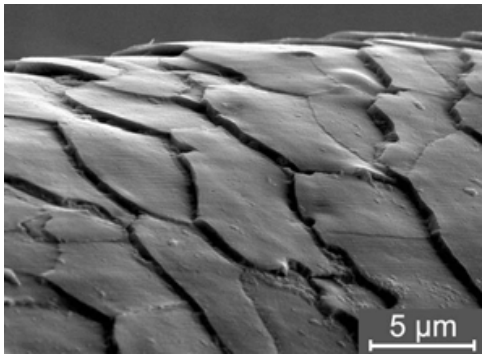
These harmful substances get released on the skin surface

Penetration into the hair follicles





Non-particulate substances do not penetrate into the hair follicles, whereas particles penetrate efficiently into the hair follicles.



Sooty particles are pushed into the hair follicles by washing the skin (massage)

Storage of nanoparticles in stratum corneum and in the hair follicles

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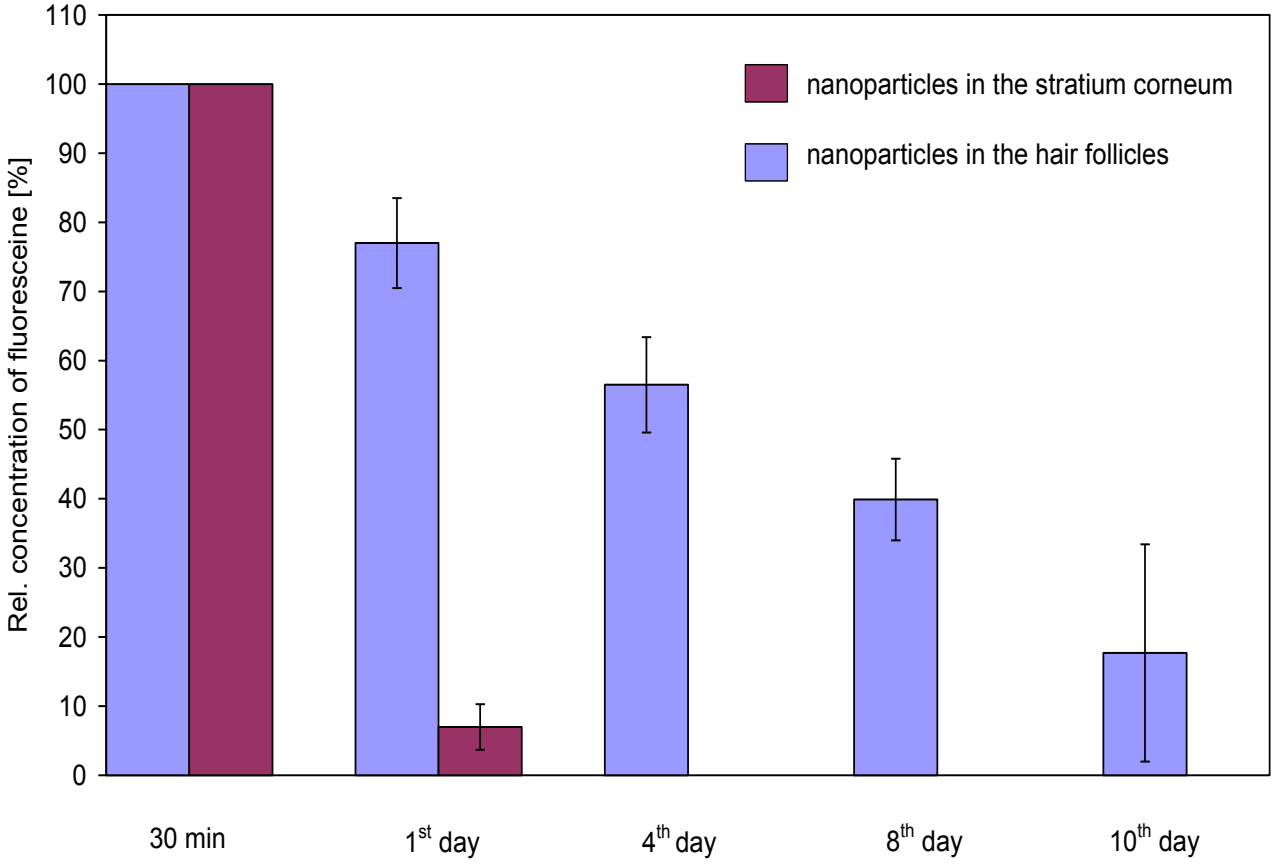
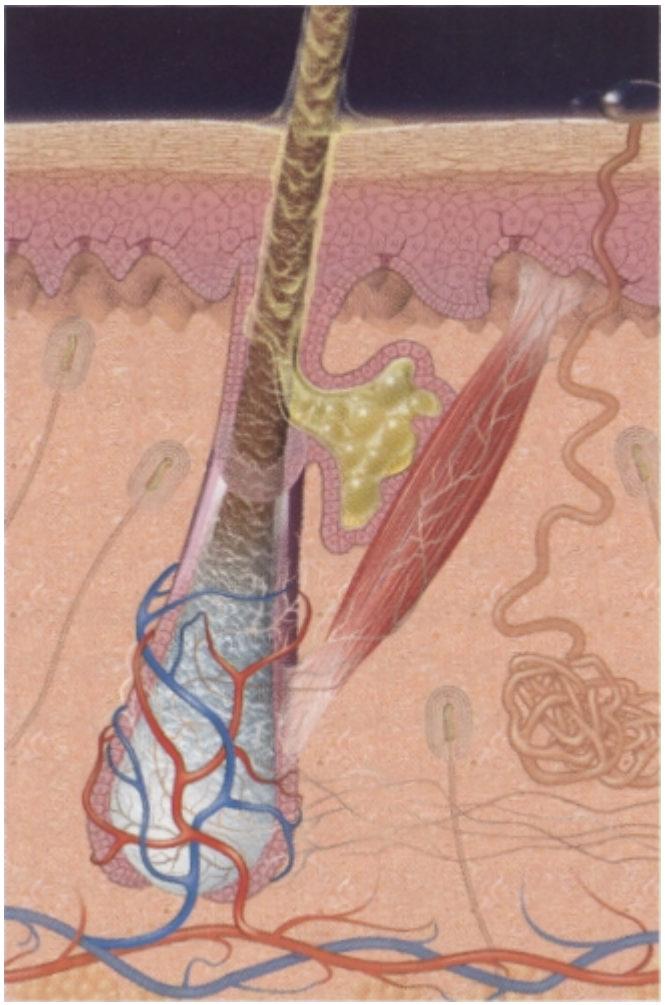
(in vivo measurements, NP 300nm)



J. Lademann et al., *Europ. Jour. of Pharm. and Biopharm.,* 2007

The hair follicle as target structure

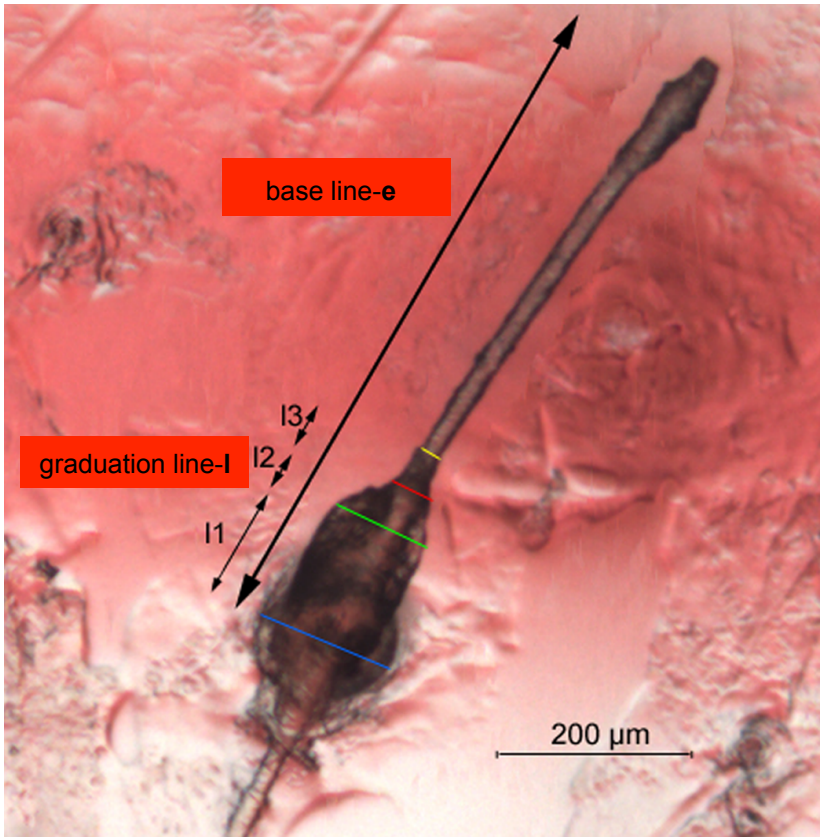


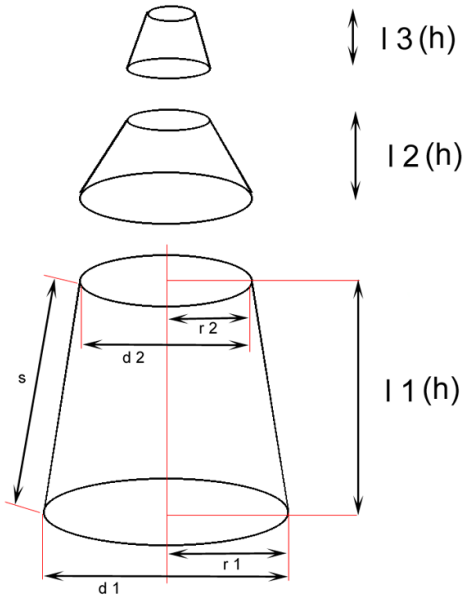
Dense network of blood capillaries
(uptake of drugs)

Location of the stem cells
(regenerative medicine)

Location of Langerhans cells
(immunomodulation)

Measurement and calculation of the infundibular volume

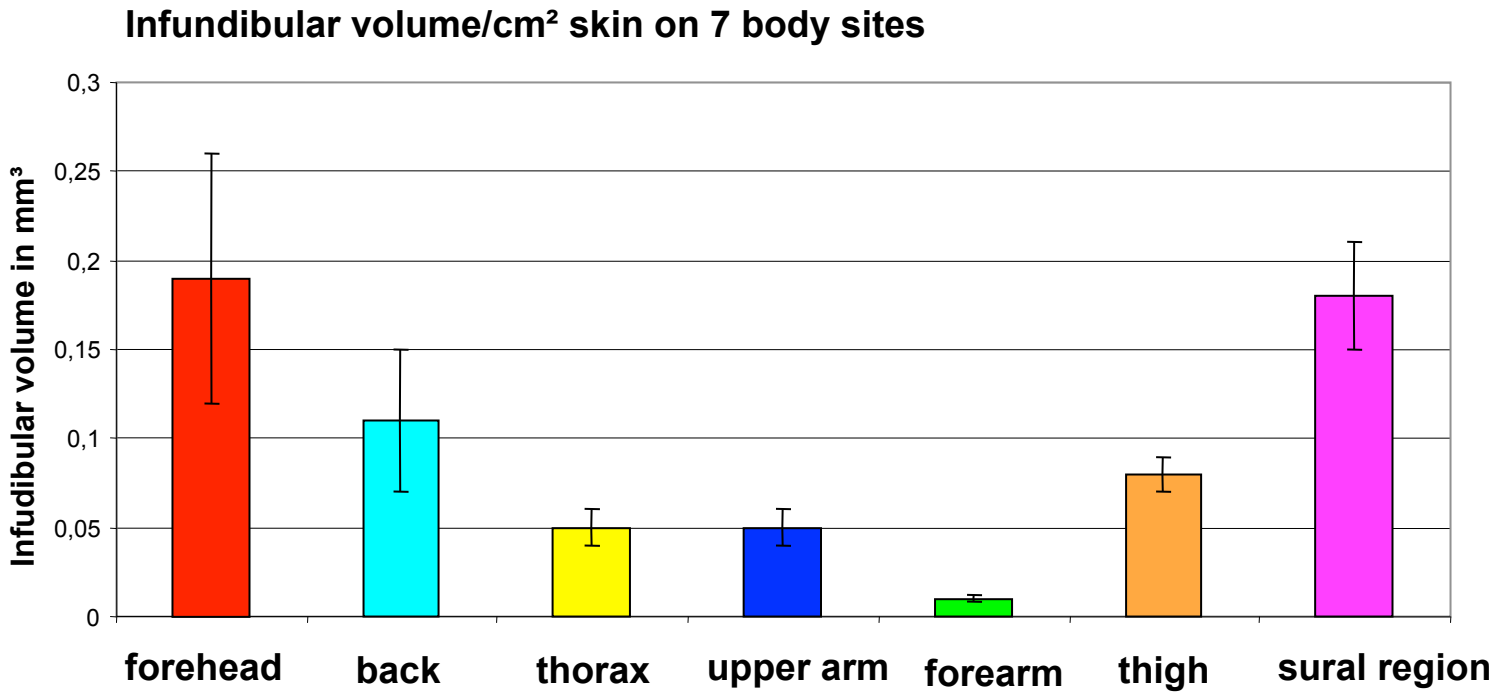




$$\mathbf{V} = \pi/12\ h(d_1^2 + d_2^2 + d_1 d_2)$$
$$\mathbf{A} = \pi s(r_1 + r_2)$$
$$\mathbf{s^2} = (r_1 + r_2)^2 + h^2$$

Otberg et al. J. Invest. Dermatol. 2003

Infundibular volume



Otberg et al. J. Invest. Dermatol. 2003

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Conclusion

The skin should not be washed after contamination.
The particles on the skin should be removed by highly absorbent materials.

Schill & Seilacher has developed highly absorbent nanofibers
that are forming a textile material

3 Studies were carried out at the Center of Experimental and Cutaneous Physiology at the Charité – Universitätsmedizin in Berlin

1.Study: Removal of high adsorbing water proven sunscreens from the skin
2.Study: Comparison of two different absorbing textile material
3.Study: Removal of nanoparticles from the skin

Application of *in vivo* laser scanning microscopy

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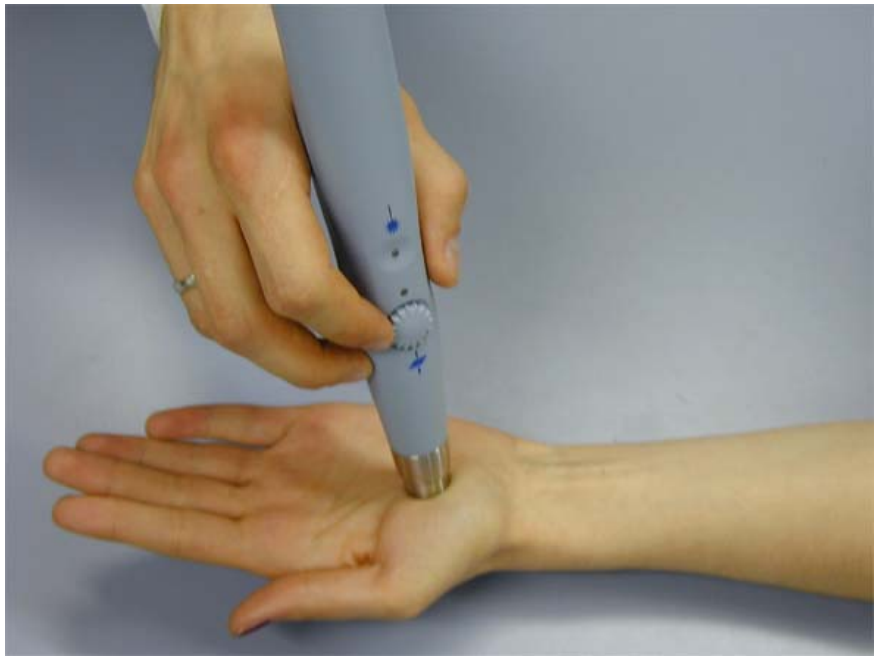
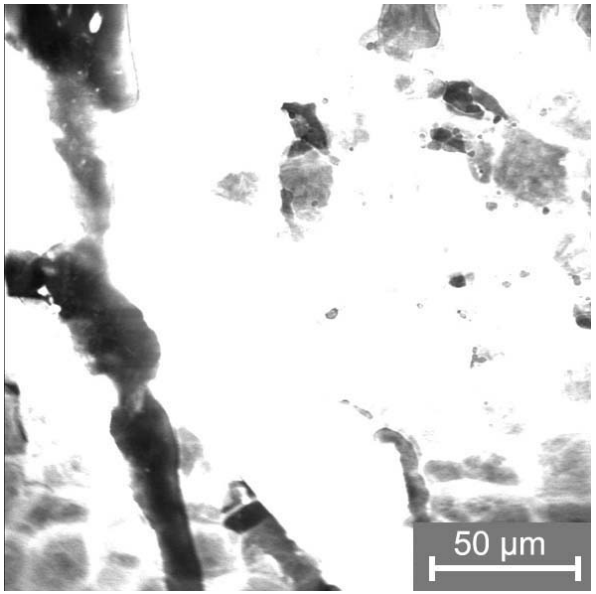
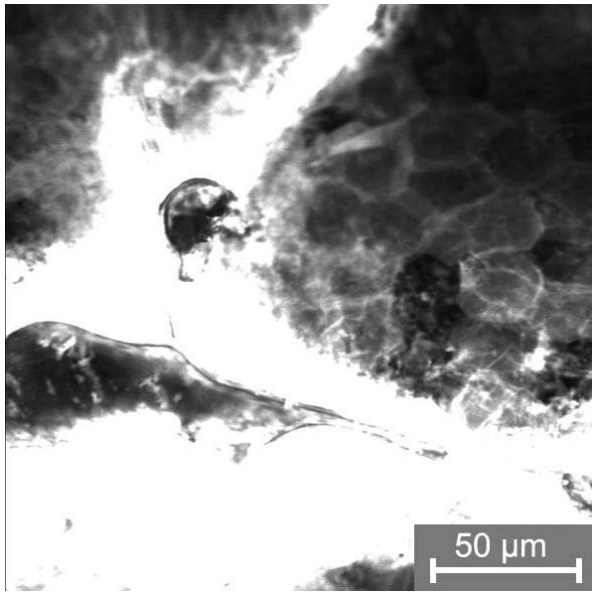


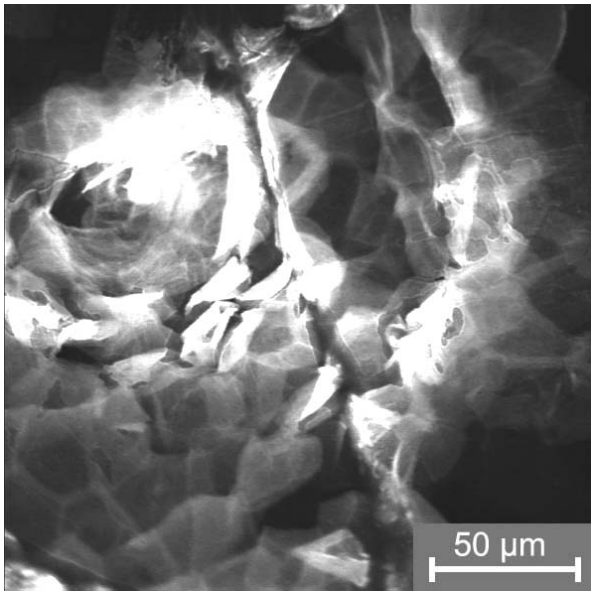
Study 1

Distribution of the water resistant sunscreen after application and penetration and after washing of the skin



Sunscreen after application and penetration

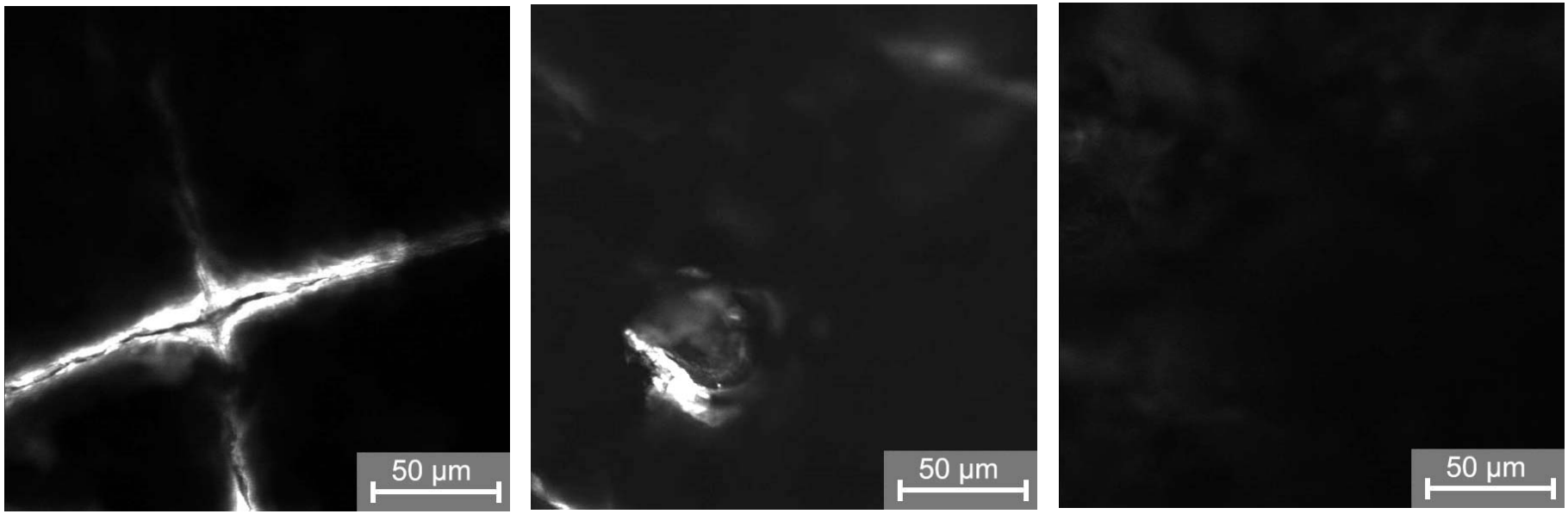




Sunscreen after washing with rinsing water

Study 1

Distribution of the sunscreen after application and penetration and after washing of the skin

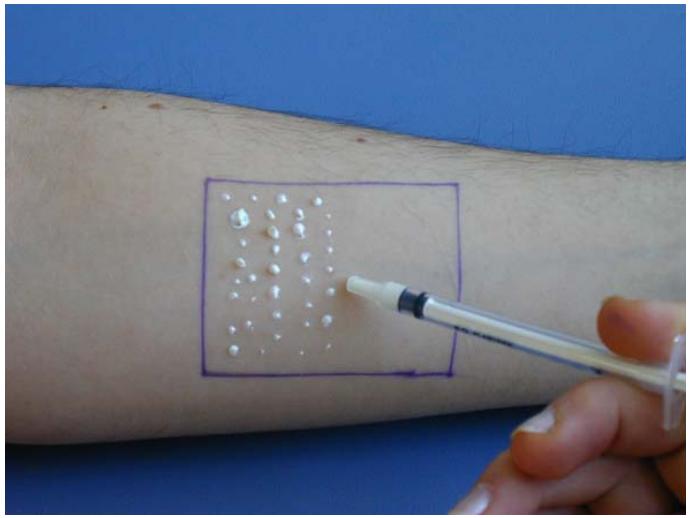


After application of the absorbent material

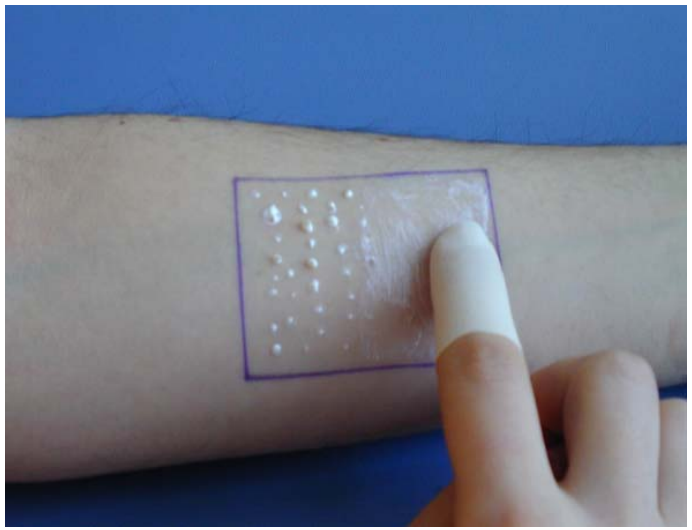
Study 2

Method of tape stripping

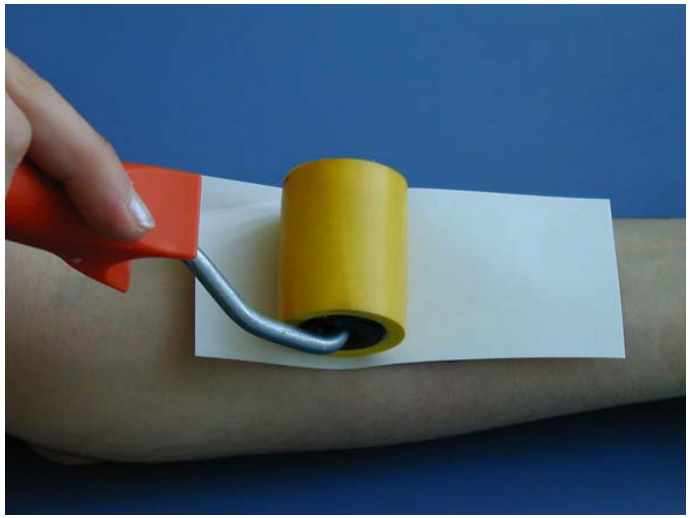
Center of Experimental and Applied Cutaneous Physiology



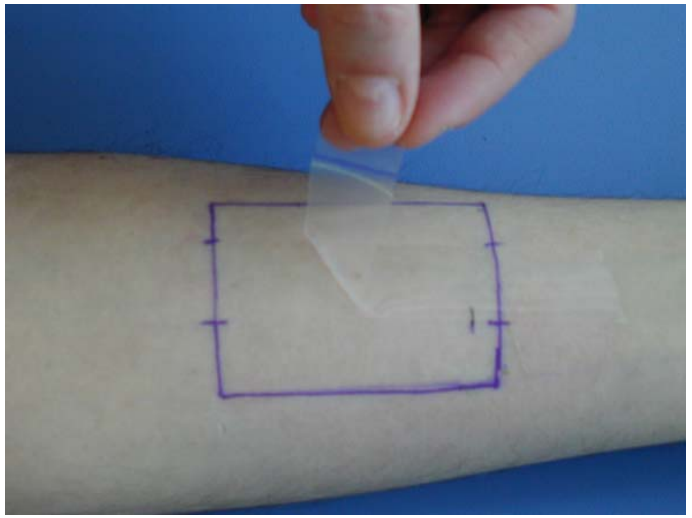
Application of the emulsion



Homogeneous distribution



Pressing of the tape by a roller



Removing of the adhesive film

Study 2

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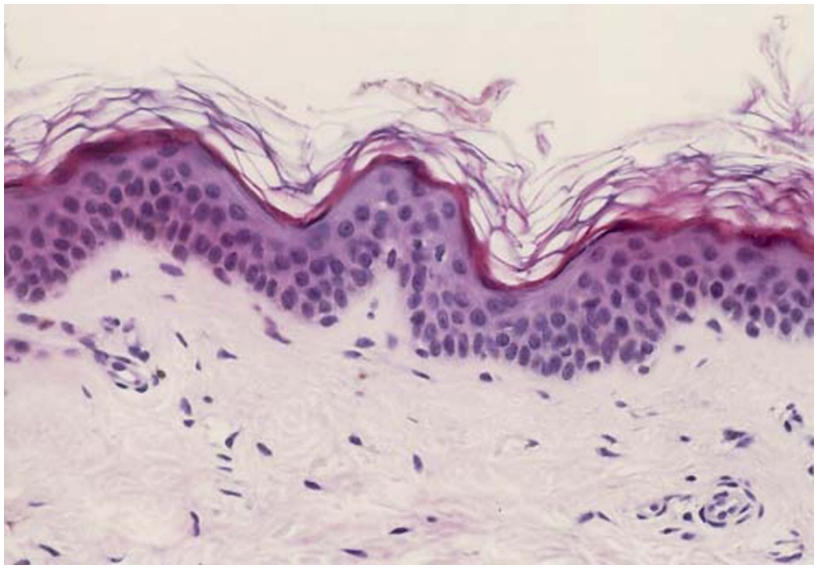
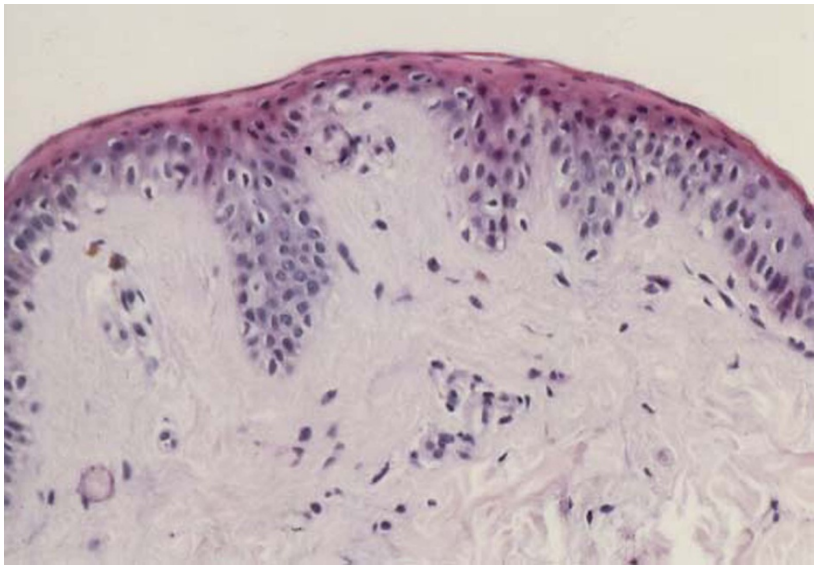
Biopsies of human skin



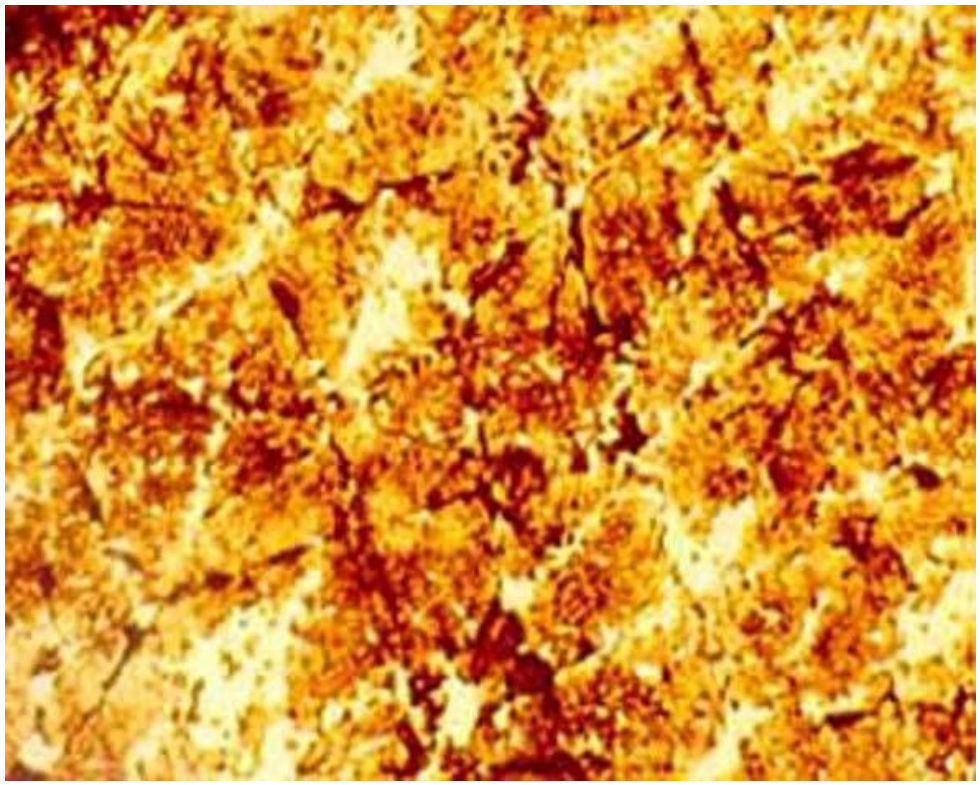
Before tape stripping



After tape stripping

Study 2

Distribution of the corneocytes on the removed tape strip



1. Tape strip

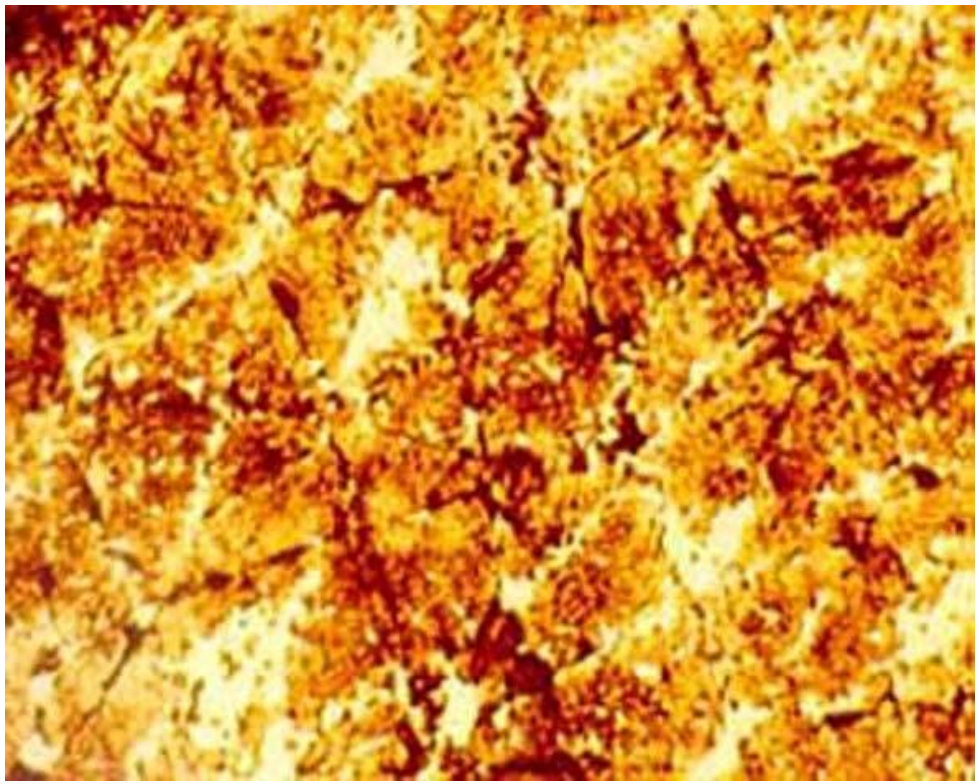
Study 2

Distribution of the corneocytes on the removed tape strip

Center of Experimental and Applied Cutaneous Physiology

1. Information:

Amount of SC



2. Information:

Amount of drug

1. Tape strip

Determination of the penetration profile

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Study 2

Traditional method

UV/VIS spectroscopy, XRF, AAS, HPLC, GC/MS

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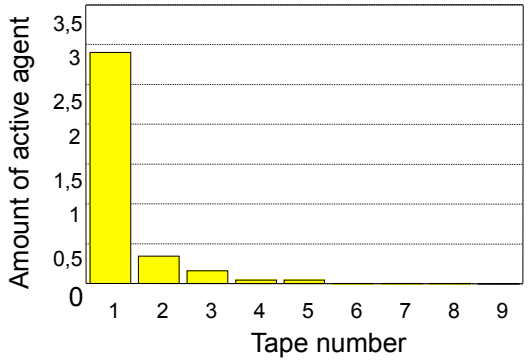
Concentration on the single tapes



Study 2 Determination of the penetration profile

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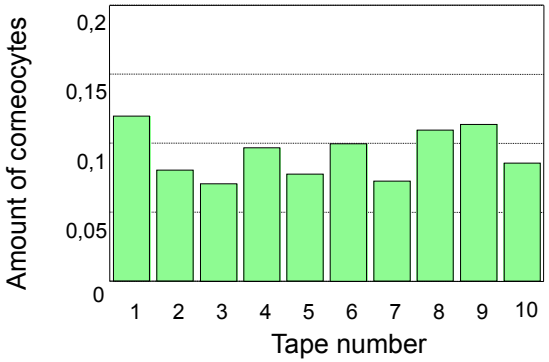
Extended method

UV/VIS spectroscopy

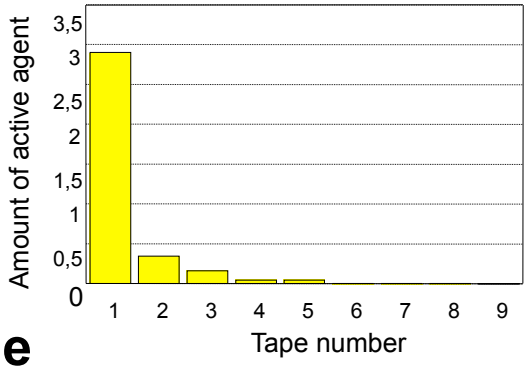
Horny layer profile



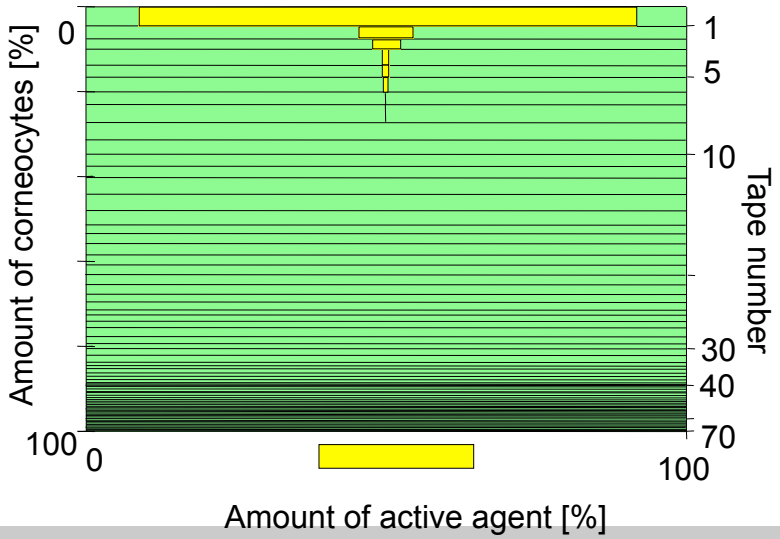
Traditional method

UV/VIS spectroscopy, XRF, AAS, HPLC, GC/MS

Concentration on the single tapes



Penetration profile



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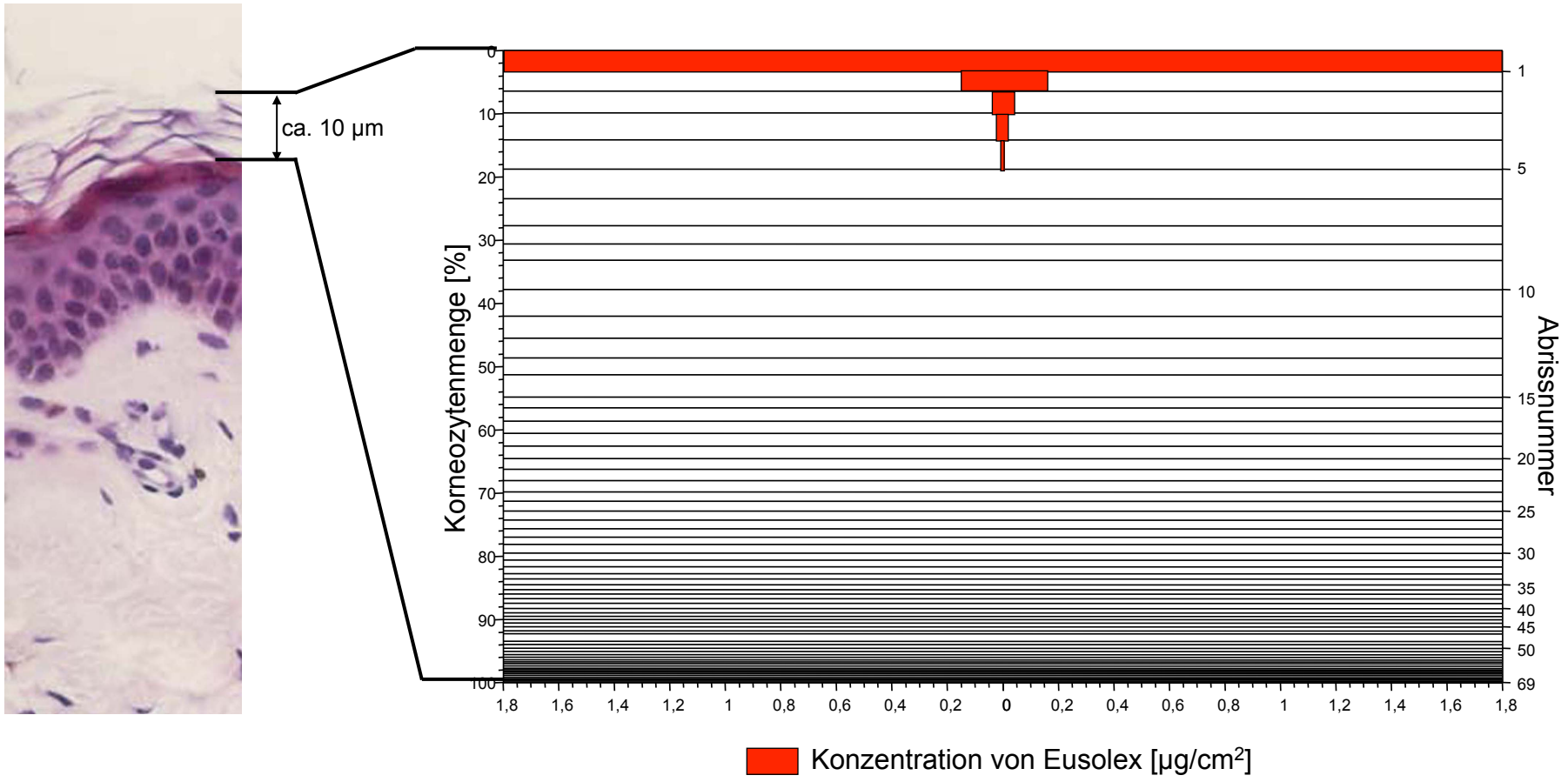
Study 2

Penetration of a UV filter (Parsol 1798) into the stratum corneum



Study 2

Center of Experimental and Applied Cutaneous Physiology

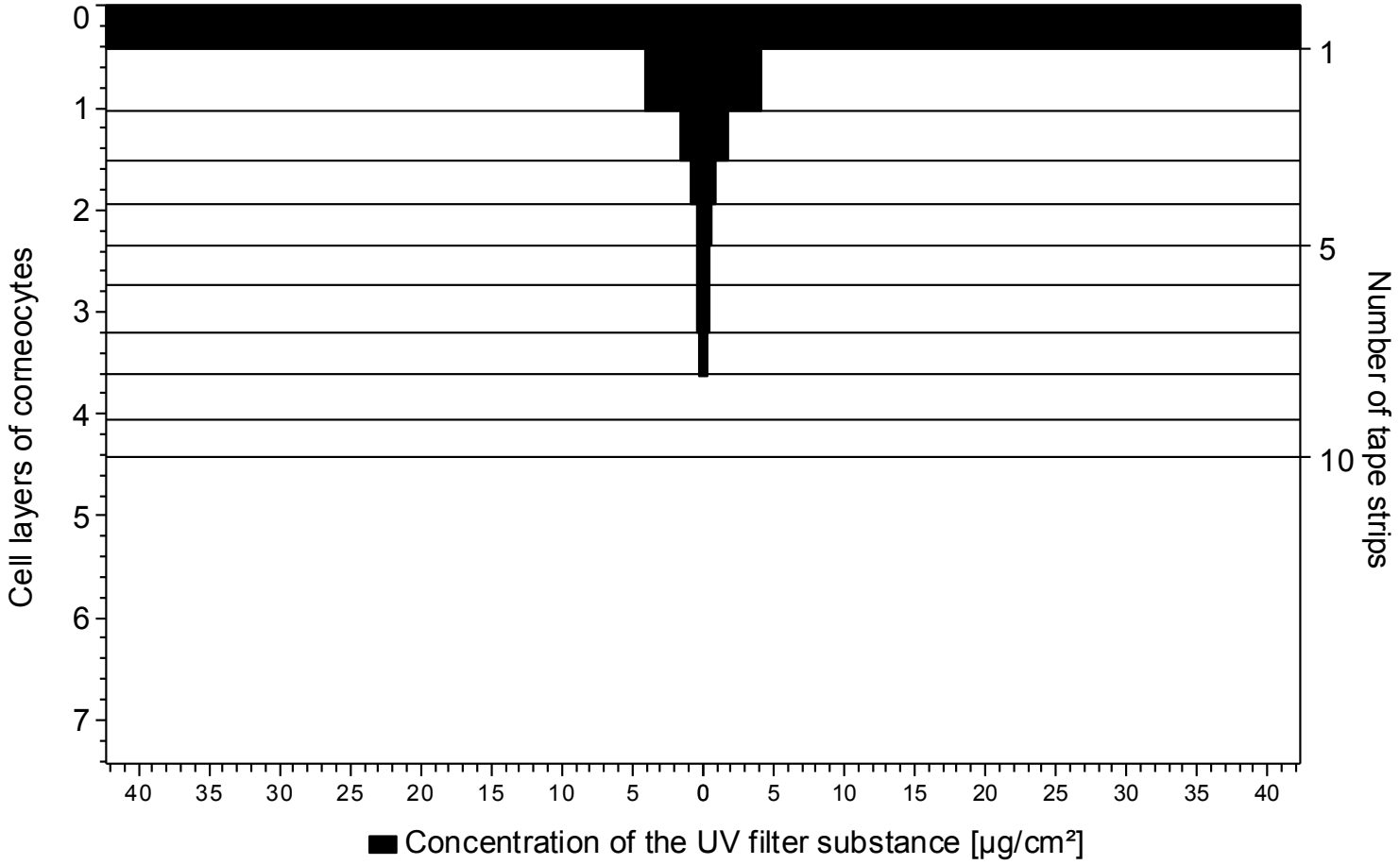
Two types of absorbent materials were used

Material 1: Constructed of superabsorbent particles in a matrix of nonwoven polyurethane nanofibers.
Diameter of the nanofibers: 400 nm up to 1 µm
Characteristic surface values: 250 to 300 g/m2 .

Material 2: Three-layer construct, top and bottom layers were pure polyurethane nanofibers
Diameter of the fibers: 400 nm to 1 µm
Characteristic surface values: 250 to 300 g/m2

Study 2

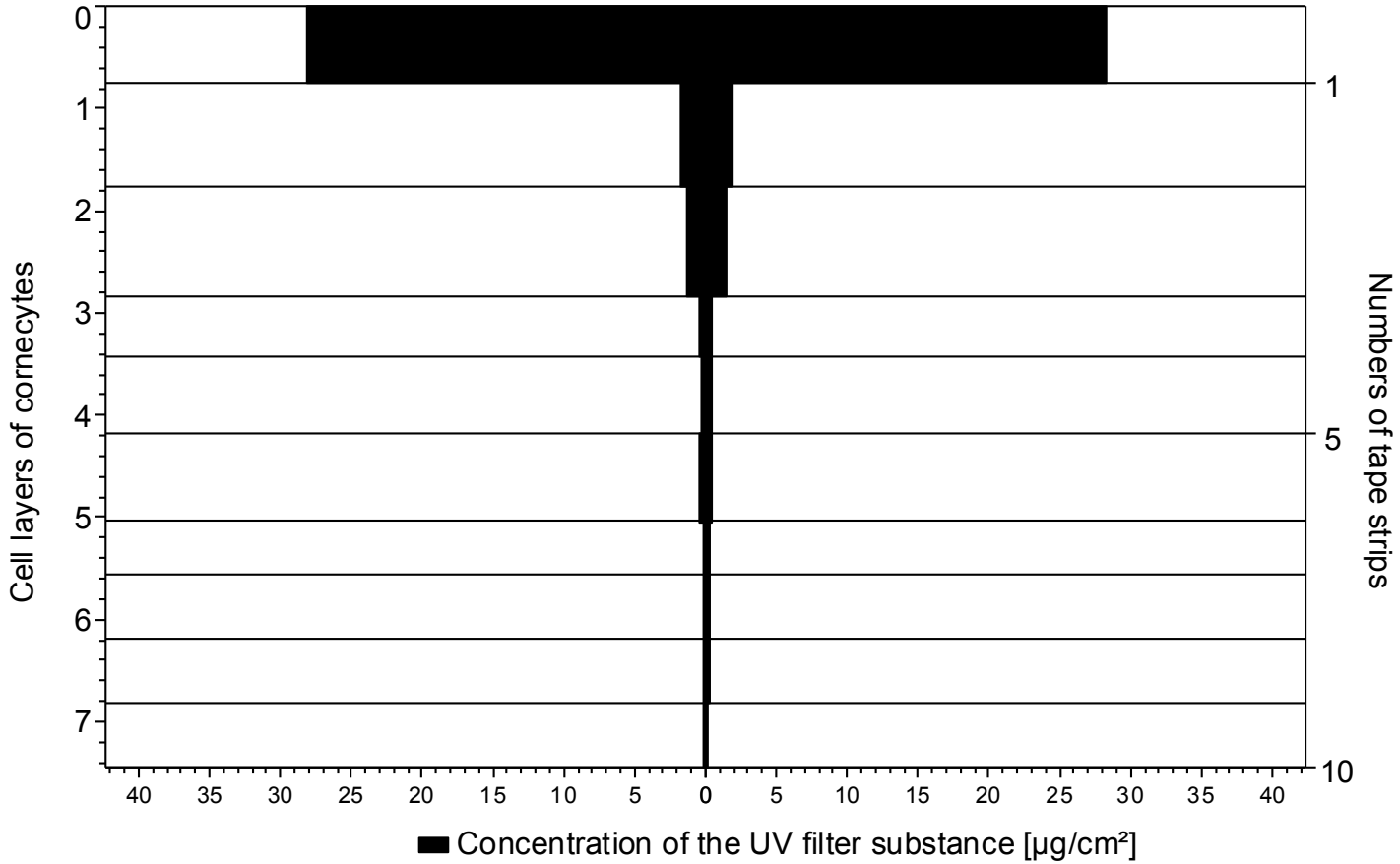
Penetration profile of the sunscreen into the skin



Study 2

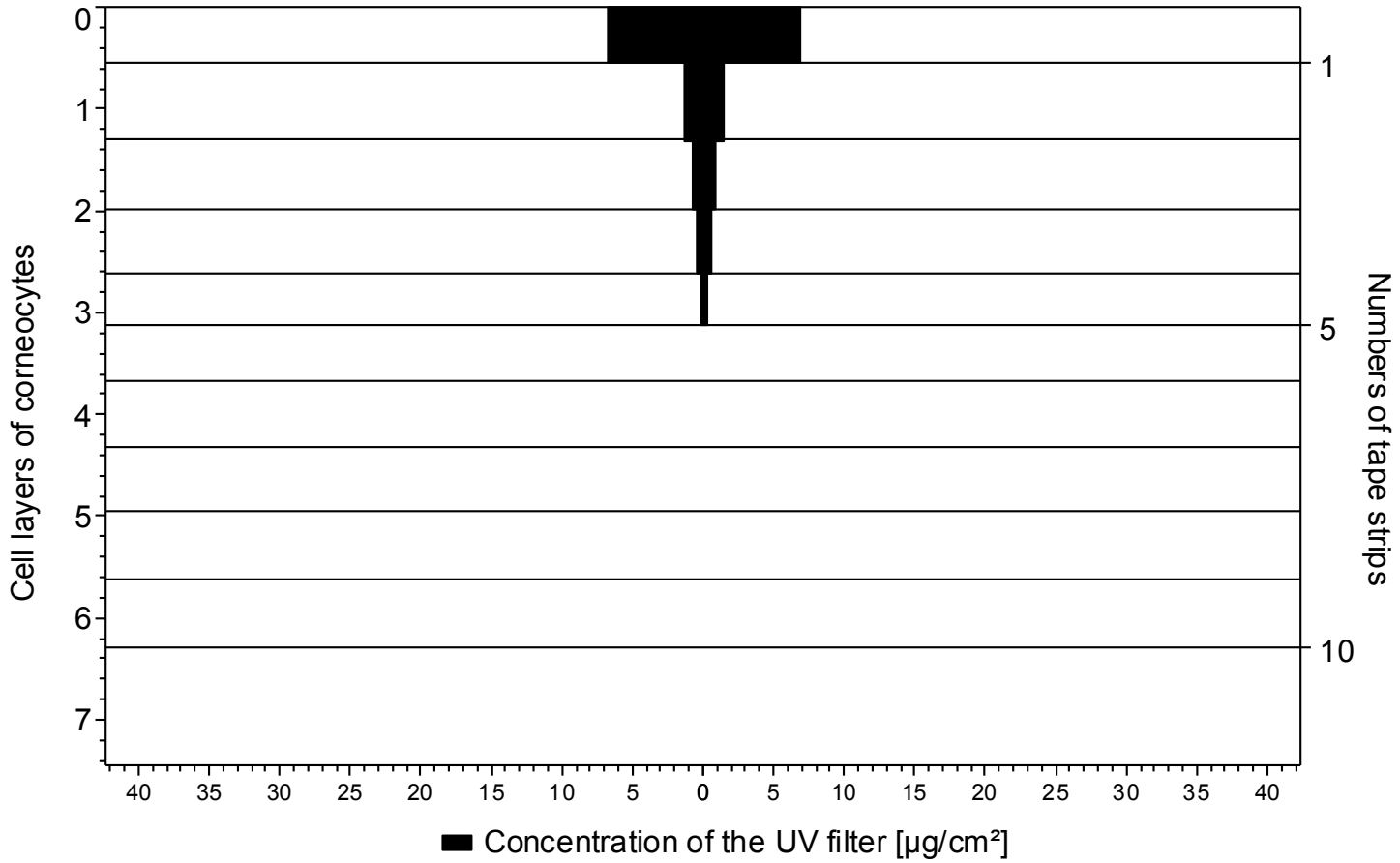
Center of Experimental and Applied Cutaneous Physiology

Penetration profile of the sunscreen into the skin after washing



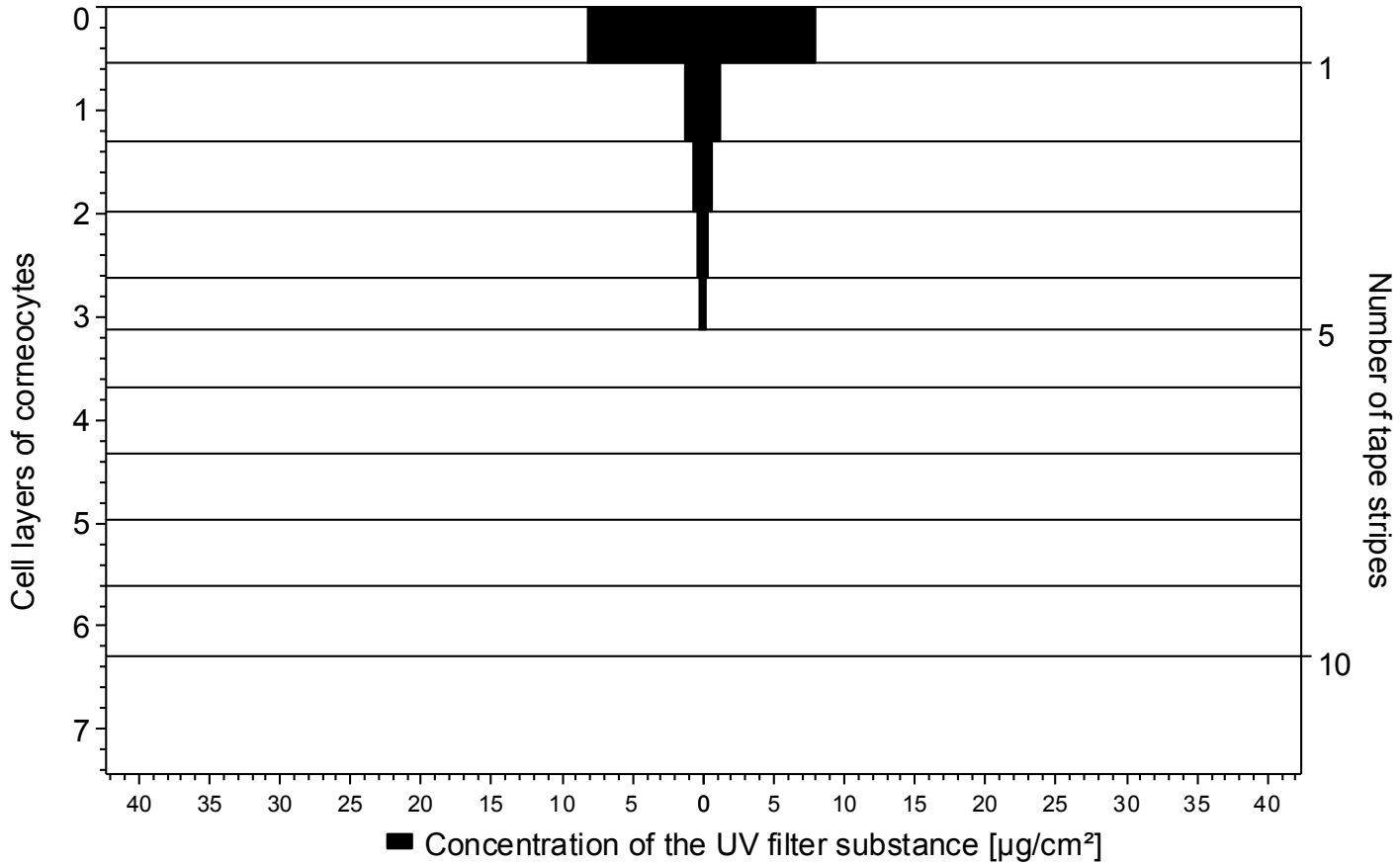
Study 2

Penetration profile of the sunscreen into the skin after application of textile material 1



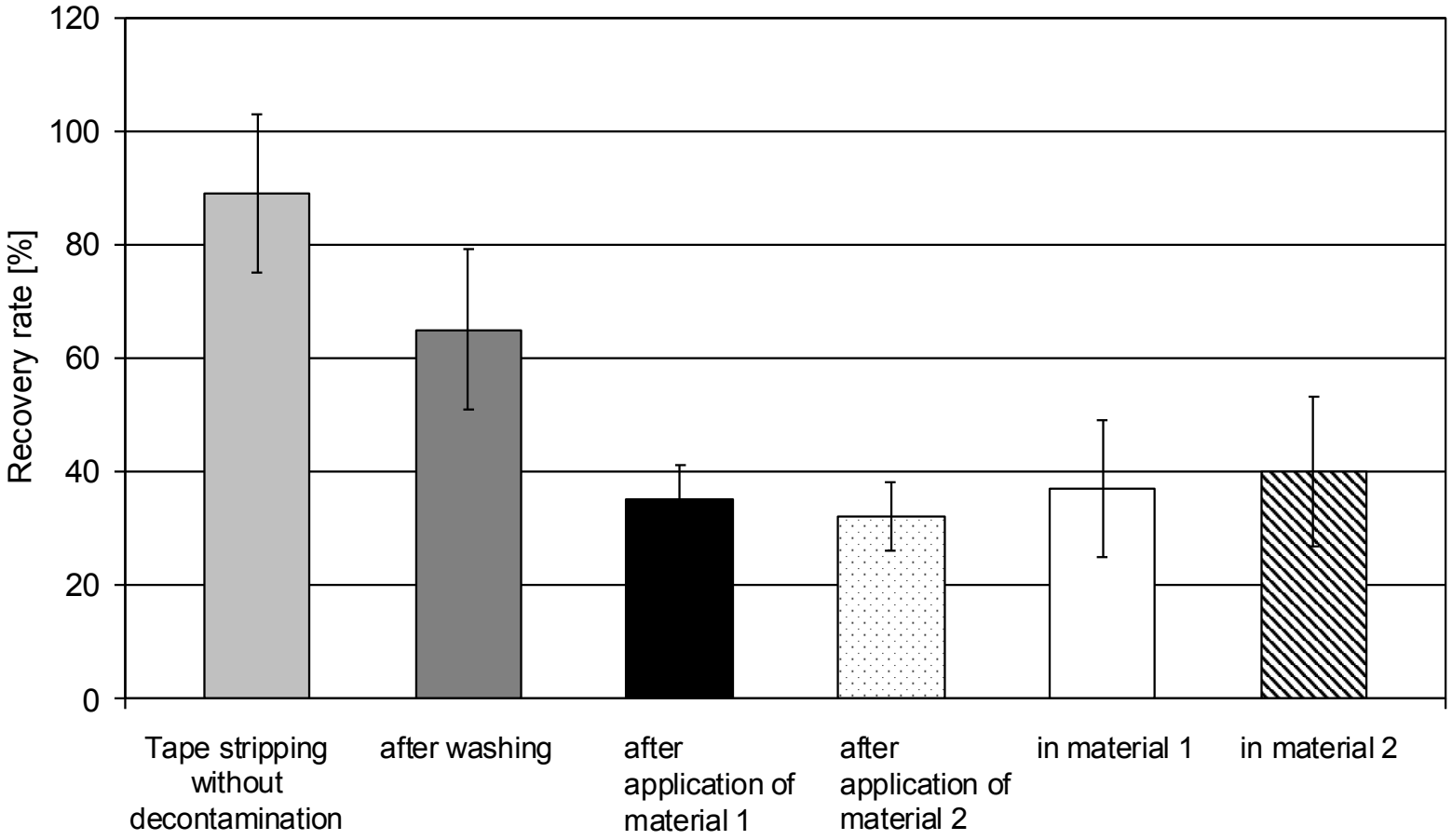
Study 2

Penetration profile of the sunscreen into the skin after application of textile material 2



Study 2

Comparison of different treatments



Study 3

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Decontamination of particles

Material: Absorbent textile material, 3 layers (SNS Nano Fiber Technology LLC, Hudson, OH. USA), top and bottom layers consisted of polyurethane nanofibers,
Diameter of the nanofibers: 400-800 nm

Particles: Soot particulates, 600 nm (IUF - Leibniz Research Institute for Environmental Medicine, Düsseldorf, Germany) labelled with the fluorescent dye sodium fluorescein

Adhesion promoter: PEG-12 Dimethicone (Schill+Seilacher, Böblin)

Study 3

Skin surface contaminated with particles

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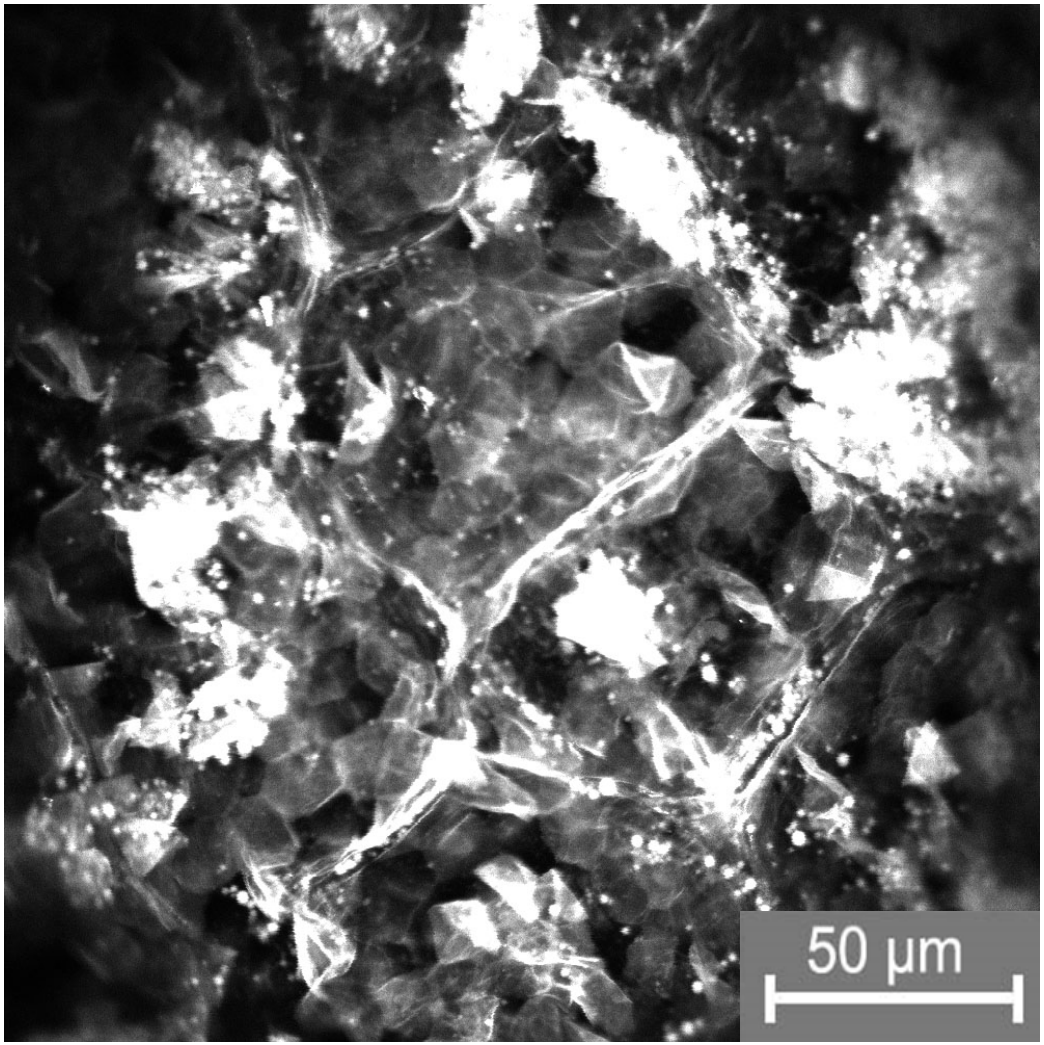
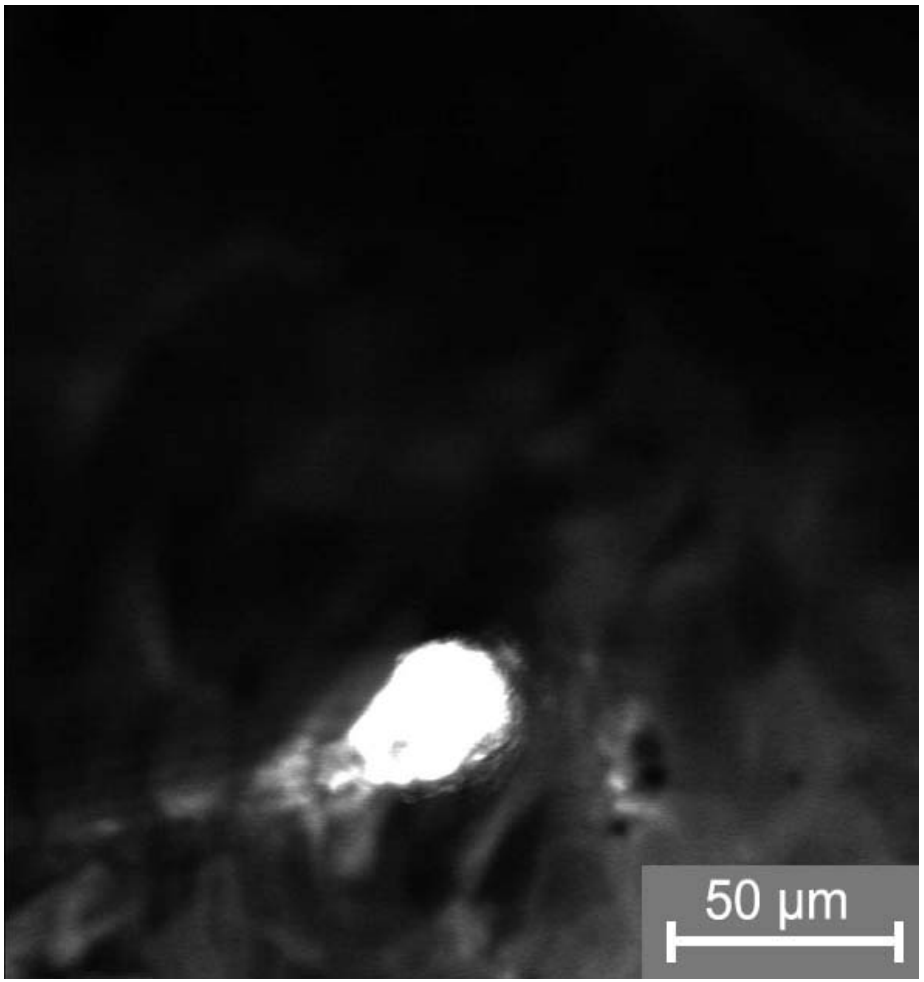


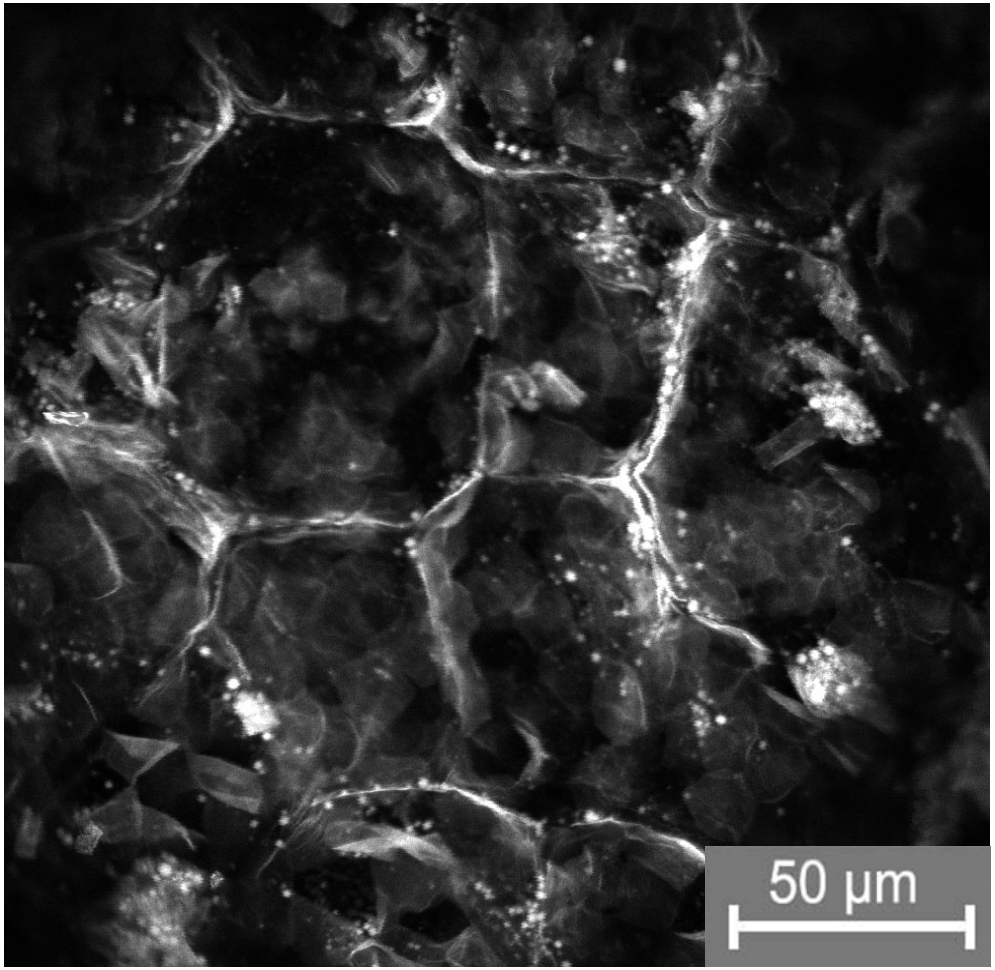
Study 3

Skin surface contaminated with particles after washing and scrubbing



Study 3

Skin surface contaminated with particles after textile contact



Study 3

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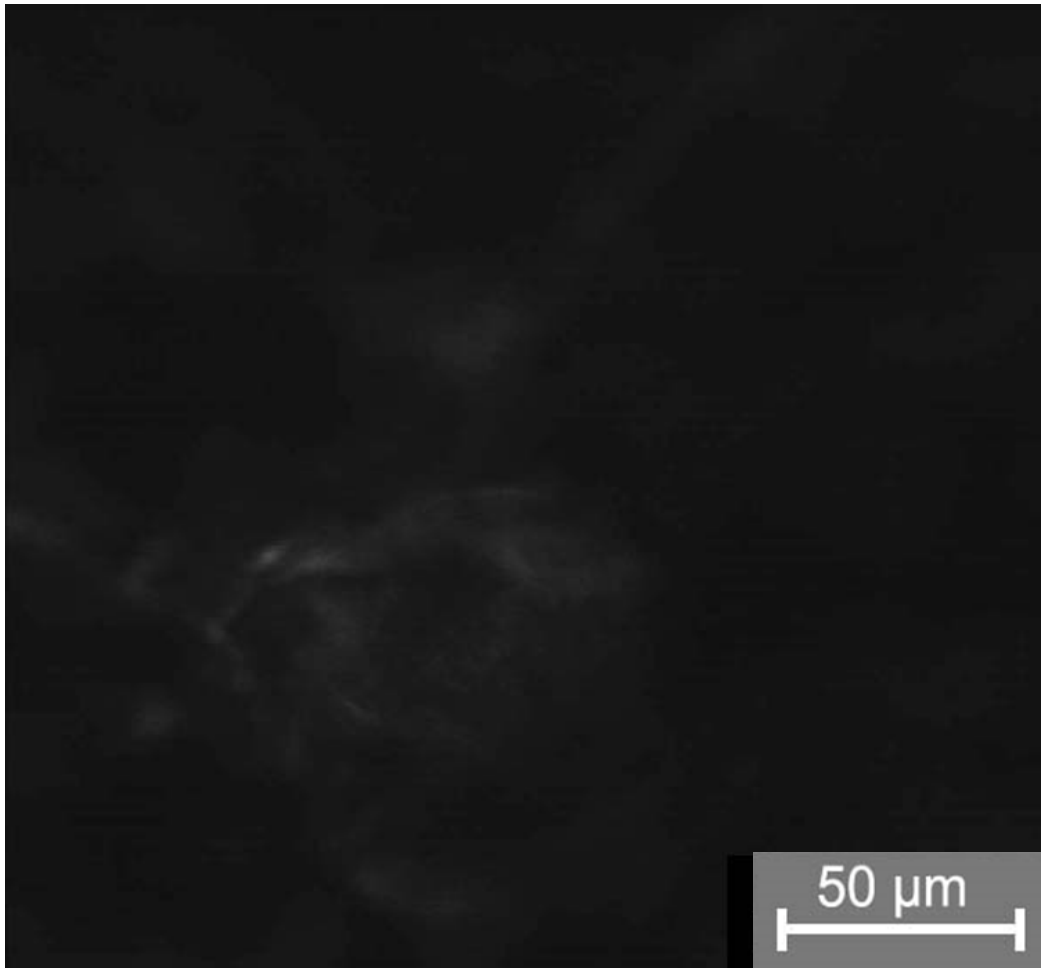
Skin surface contaminated with particles after spray-treatment and textile contact



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Thank you!

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