Drug absorption by skin treated by microplasma discharge

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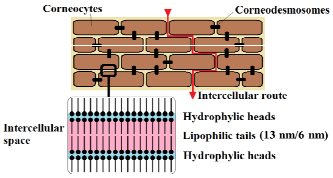
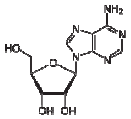
Introduction

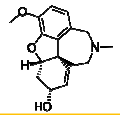
Stratum corneum is first barrier that protect our body and does not allow penetration of amount of objects such as drugs. Intercellular route is very often used for drug penetration when stratum corneum lipids are extracted or their structure is changed. Change of properties of the skin surface can change flow of transdermal drug delivery – if the drug is force to adsorb on the skin surface.



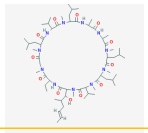
Adenosine: hydrophilic drug
For treatment of abnormally fast heart rhythm
with molecular weight of 267 Da



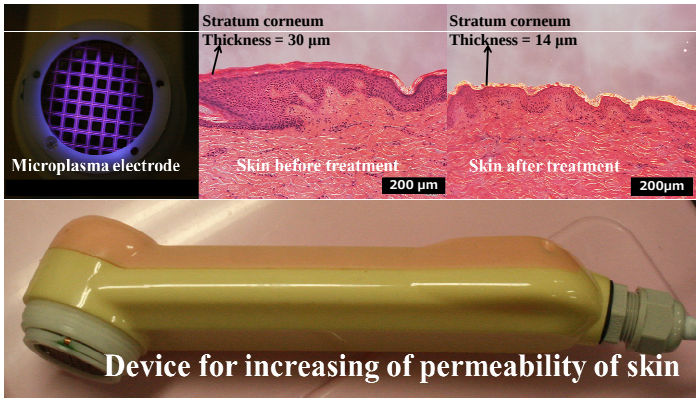
Invetigation of the skin absorption of Galantamine Hydrobromide: hydrophilic drug for Alzheimer disease with molecular weight of 287 Da



Cyclosporine A: Lipophilic drug As imonosupressive drug during and after transplantation of organs with molecular weight of 267

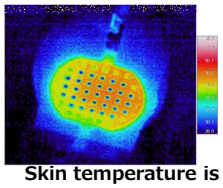


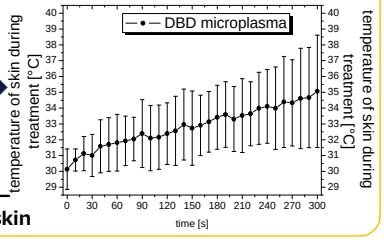
Etching effect of the microplasma treatment of the pig skin



Temperature of plasma treated skin

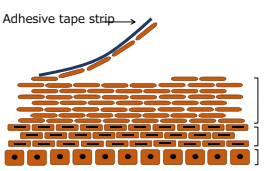
Ar microplasma discharge

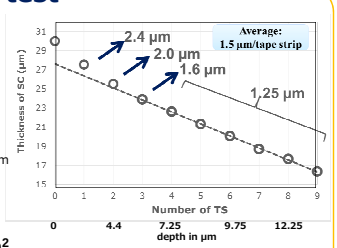




Skin temperature is under 45°C – No temperature damage of the skin

Tape tripping test



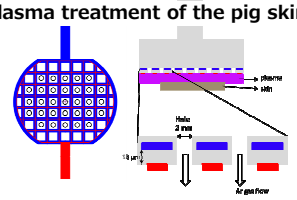


Stratum corneum density ρ= 1g/cm³
Surface area S = (1.5 x 1.5) cm²
Removed thickness d = m/(ρ S)

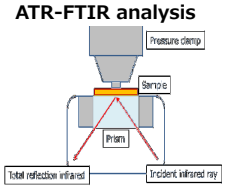
Tape stripping allow as to analyze depth of influence of the microplasma

ATR-FTIR characterization of the pig skin

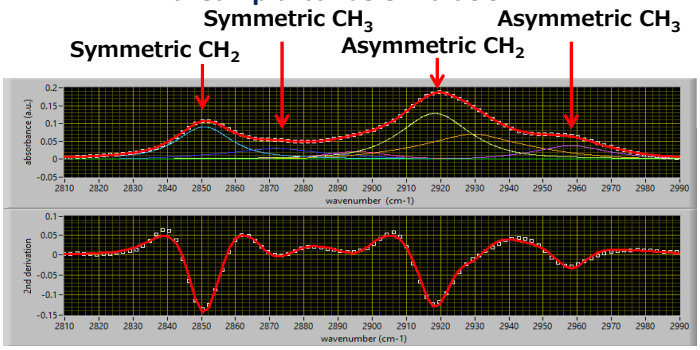
Plasma treatment of the pig skin

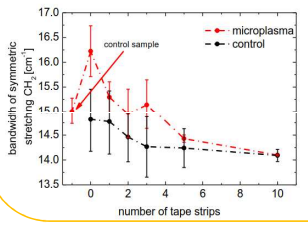


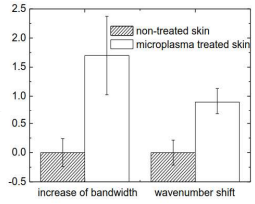
ATR-FTIR analysis



Infrared lipid bands simulation



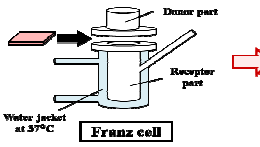




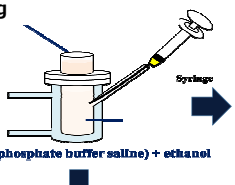
Increase of the bandwidth and wavenumber shift indicate disturbation of lipid structure

High Performance liquid Chromatography (HPLC)

Skin sample was placed into Franz cell up to 2-3 min after treatment by plasma

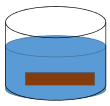


drug



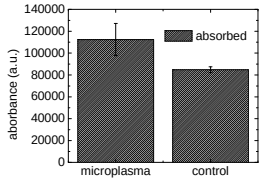
HPLC analysis

Skin soaked in drug solvent For 24 hour



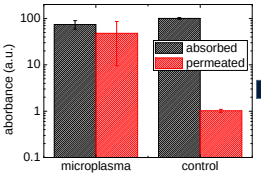
HPLC analysis

Skin permeability/absorption



Absorption of Cycloporine A

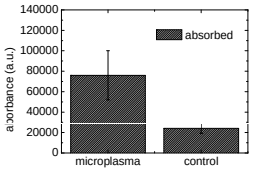
After plasma treatment, absorption of the skin for Cyclosporine A increased about 32%



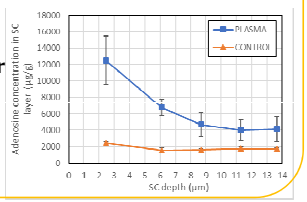
Absorption and permeability of GaHBr

After plasma treatment, absorption of the skin for GaHBr was comparable with non-treated skin but permeability increased significantly

Absorption of Adenosine



After plasma treatment, absorption of the skin for GaHBr was comparable with non-treated skin but permeability increased significantly



Conclusions

- Microplasma irradiation can etch the surface of the skin
- Plama temperature allows safe skin treatment
- Microplasma diturb structure of the skin lipids (ATR-FTIR meaurements)
- Microplasma can improve drug absorption of the skin or permeability of the skin