

TERAHERTZ SKIN SENSING

Developing next-generation, non-invasive terahertz (THz) tools to revolutionise skin health assessment and cosmetics research.

OUR GOALS

- ✓ Apply our experience from skin and cancer measurements for use in the cosmetics industry.
- ✓ Learn from industry and develop mutually beneficial collaborations.



OUR APPROACH



Cutting-edge instrumentation

Combining sensitive THz instrumentation with high performance robotics.



Enhanced measurement capability

Measuring THz light and pressure simultaneously to enhance measurement reliability and capability.



Skin measurements

- Simultaneously measuring skin hydration and elasticity.
- Working towards models to determine 'Skin age'.



Multi-functional tool for multi-purpose skin-care development



- Our system is unique in its ability to capture THz measurements of the skin while subjected to different surface pressures.
- Both hydration and elasticity are measured simultaneously.
- This will be applied to industry led development into measuring skin health, damage recovery and skin ageing
- Detailed information from THz sensing will assist in measuring the effectiveness of multi-purpose products, such as UV-protecting moisturisers.

THE TERAHERTZ SPECTRUM



- The THz spectrum is located between microwaves and infra-red with wavelengths between 0.01mm and 1mm.
- THz light is non-ionising – it is a million times lower energy than x-rays.
- THz light is extremely sensitive to water, due to intermolecular hydrogen bonds having absorptions at THz frequencies.

Building on previous work

- Our current tools and techniques were developed for skin and cancer diagnosis
- Testing has already begun in clinical settings, measuring patients and evaluating data.
- Co-development with industry will transition these methods towards THz technology for skin-health and cosmetics research and development.



Additional information



TERABOTICS

[Terabotics Research Project](#)



@MacPhersonTHzGroup

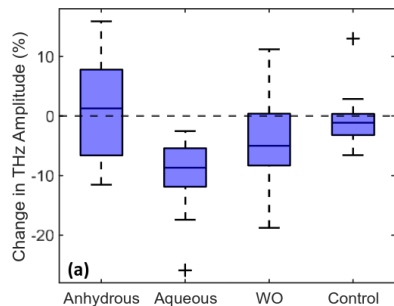
E.MacPherson@Warwick.ac.uk



TERAHERTZ CASE STUDIES

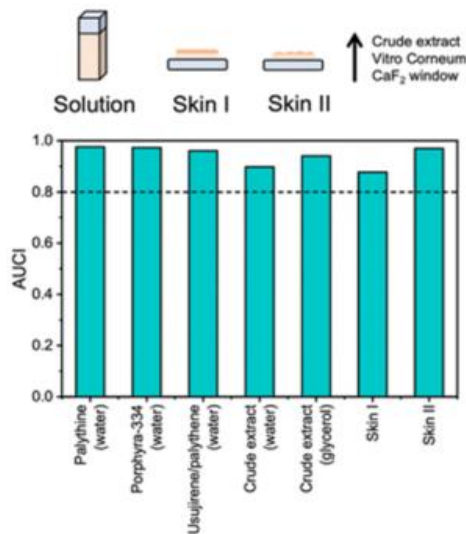
Emollient

- Quantification of skin hydration after application of different skin products.
- [Hannah Lindley-Hatcher et. al., Phys. Photonics, 2021](#)



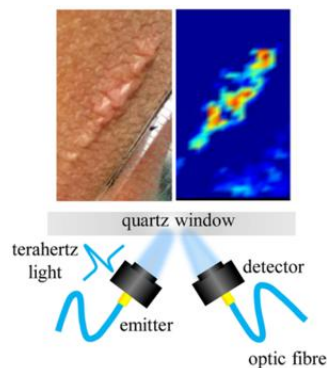
Sun cream

- Sun cream investigations using natural products.
- [Abigail L. Whittock et. al., Royal Soc. Chem, 2023](#)



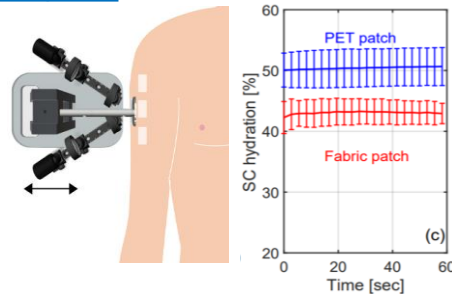
Scar healing

- Non-invasive monitoring of scar healing.
- [J Shuting Fan, et. al., Biophotonics, 2016](#)



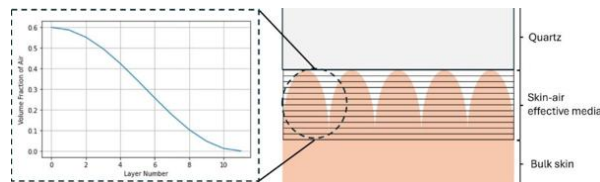
Transdermal patches

- Quantitative evaluation of the effect of transdermal patch design on skin hydration and drug delivery.
- [Arthur I Hernandez-Serrano et. al., Biomed Opt Express, 2024](#)



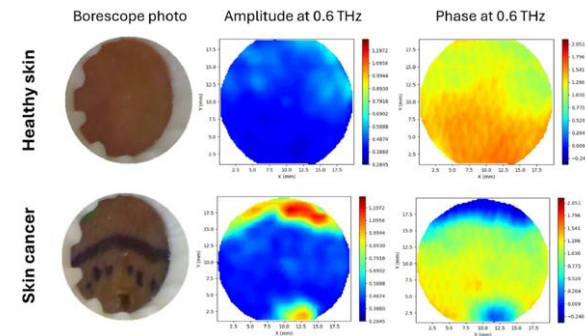
Modelling the complex skin structure

- Using experimental led data to model the complex structure of the skin.
- [Ben G Page et. al., Biomed Opt Express, 2025](#)



Skin cancer detection

- THz is highly sensitive to water content, structural changes and biochemical composition.
- Several research groups around the world are investigating the use of THz sensing for skin cancer detection.
- [Agrima Agarwal et. al., JPhys Photonics, 2026](#)



Video and fast imaging

- Integration of advanced optics to achieve world first imaging speeds for THz reflection geometry (over 10 frames per second).
- This also increases spatial resolution due to using optical light patterning.
- Paving the way to real time *in vivo* imaging
- [Sen Mou et. al., Nature comms 2026](#)

