

The nondestructive evaluation of penetration of the cosmetic liquid into the pig skin

Graduate School of Interdisciplinary Science and Engineering in Health Systems, Okayama Univ.

*Sota Sueda, Taihei Kuroda, Kenji Sakai, Toshihiko Kiwa, Keiji Tsukada

E-mail: pvue77z8@s.okayama-u.ac.jp

1. Introduction

In the process of development of cosmetic liquids, it is required to evaluate a penetration depth and speed into the skin. A tape stripping method⁽¹⁾ is conventionally used to evaluate penetration of the cosmetic liquids. However, the tape stripping method requires florescent dyes to measure the penetration depth. Also, the tape stripping method cannot evaluate the penetration speed because it is destructive evaluation method.

In our group, we applied a terahertz time-of-flight measurement (THz-TOF) method to evaluate the penetration depth and speed nondestructively⁽²⁾. We have demonstrated the time evolution of penetration of cosmetic liquids using chicken skins.

In this study, we used Yucatan micropig skins for evaluation and effect of glycerin and ethanol concentration dependences on penetration speed was evaluated.

2. Experiment

Figure 1 is a schematic of our experiments. The 5-months-old micropig skin was mounted on a sensing plate, which consisted of Si thin films on a sapphire substrate. The micropig skin was well used for evaluating penetration of cosmetic liquids or ointments. THz pulses were radiated from the sensing plate by irradiation Si thin film by a femtosecond laser. Most part of radiated THz pulses were directly radiated into free space (wave 1) and some THz pulses are reflected at the boundary between the penetrated and none-penetrated regions of the cosmetic liquids (wave 2). When the cosmetic liquid penetrated deeper into the skin, the boundary approached to the sensing plate, the difference in the arrival timing of wave2 and wave1 to a THz detector decreases.

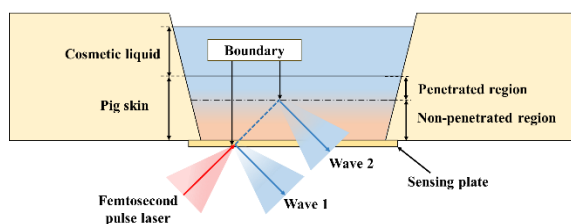


Figure 1: Schematic of measurement

3. Results

We used mixture of distilled water, glycerin, and ethanol (99.5 %) was used as the cosmetic samples. The weight ratio of water and glycerin was 1 g:1 g, and the weight of ethanol was changed from 0.125 g to 0.500 g.

Figure 2 shows time change of difference in the arrival timing of wave 2 and wave 1. The sample liquid was dropped at time was 0 min., therefore, the negative values of time difference indicates the liquid is penetrated into the skin. One can see the liquid did not penetrate deeply into the skin for the ethanol concentration of 0.125 g even after 30 min. The liquid with the ethanol of more than 0.200 g was deeply penetrated the skin. This may be caused by destruction of oil film on the skin by ethanol.

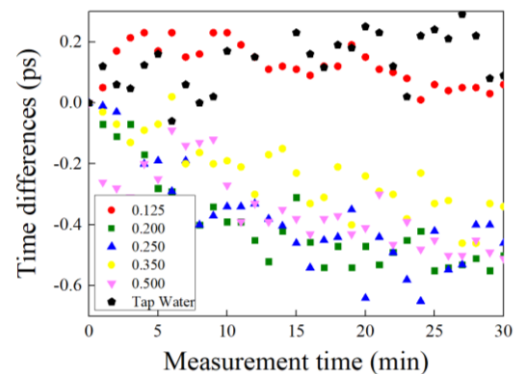


Figure 2: Penetration evaluation of 5 type s of cosmetic liquids and tap water

4. Conclusion

Penetration of pre-mixed cosmetic liquid into micropig skins was evaluated. The result suggests that the concentration of ethanol in the liquid effect on the penetration.

references

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2. T. Kuroda, et al., Proc. 43rd Conf. IRMMW 2018, DOI: 10.1109/IRMMW-THz.2018.8510287 (2018)