FABRICATION OF ARTIFICIAL SKIN FOCUSED ON RADIATIVE CHARACTERISTICS OF ITS SURFACE STRUCTURE

Kae Nakamura[1]*, Takahiro Kono[2], Atsuhiro Goto[3], Hiroki Gonome[4], Jun Yamada[2]

[1] Nihon University, 7-24-1 Narashinodai, Funabashi-shi, Chiba, 274-8501, Japan
[2] Shibaura Institute of Technology, 3-7-5 Toyosu, Koto-ku, Tokyo, 135-8548, Japan
[3] Olympus Corporation, 2-3-1 Nishi-Shinjuku, Shinjuku-ku, Tokyo, 163-0914, Japan
[4] Yamagata University, 4-3-16 Jonan, Yonezawa, Yamagata, 992-8510, Japan

Introduction. The most common evaluation method of cosmetics is visual inspection for the actual skin with makeup. It is ideal to use artificial skin to keep evaluating under the same condition all the time. Such artificial skin is required reproducing completely the light transfers in the actual skin. However, this is difficult because it is necessary to reproduce both light propagation inside the skin and light behavior on the surface. Our research group has measured the light properties of the skin for producing artificial skin for visual evaluation [1]. This research aims at constructing the surface structure on the artificial skin which can reproduce the light diffusion on the actual skin surface.

Numerical representation of surface structure. General artificial skin is made by pouring colored silicone resin and/or urethane resin into a molding container and curing it. When a surface structure on artificial skin is created, it is possible by making a mold of the structure on one side of the molding container. The important point of the structure of the mold is not the individual morphology of the skin but the one that can reproduce the general light diffusion properties of the actual skin surface. In this regard, our previous research findings, that is the light diffusion properties of the object surface depend on the tilt angle of its structure [2], was applied. The normal vector of each surface element and its inclination angle in the observed image data of the skin surface were obtained (Fig.1). And the probability density function of the inclination angle was calculated using the all surface elements. The light diffusion properties calculated using this function and the measured one of the actual skin structure were agreed. Therefore, in order to reproduce the light diffusion properties of the artificial skin surface, the function should be same as that of the actual skin. In this study, some surface processing methods to make molds that can reproduce it were attempted.

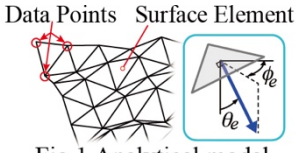

Fig.1 Analytical model of surface structure.

Mold making. A5052 aluminum alloy plate of 50 mm square and 3 mm thickness was use as the mold material. The first processing method was "Cutting", in which the surface of A5052 plate was scratched in random directions by a cutter knife. The second was "Sandblasting", in which alumina grids of 425–600 μm in size were sprayed from a position 50 mm away from the surface of the plate. The third was the "Shaking" process, in which the aluminum plate and a stainless steel ball with a diameter of 1.6 mm were placed in a container and shaken up and down manually.

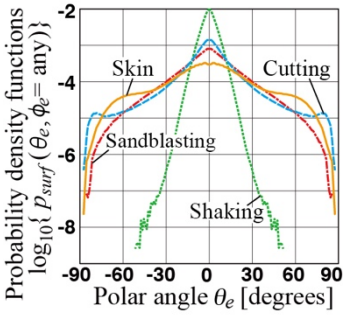

Fig.2 Probability density function for the surface structures.

Result. In the actual skin, there were many faces with the steep slope due to the groove structure on it. In the cutting process, there were many faces with large inclination. On the contrary, the surface of the mold was made by the shaking process was almost planar (Fig.2).

References. [1] T.Kono, et.al., Proc.38st Jpn. Symp.Thermophys. Prop., Tsukuba (2017), D113.
[2] K.Nakamura, et.al., Thermal Science & Engineering, 23.4 (2015), 61–69.