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〈Regular Article〉

Small-Angle X-ray Diffraction Structural Analysis of Human Hairs of Different Shapes and Effect of Straight Perming

Minori KAKIZAWA*, [1], Tomoyuki KAWASOE[1], Noboru OHTA[2], Katsuaki INOUE[2], Naoto YAGI[2], Ichiro HATTA[2]

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Abstract

A human hair shaft consists of cuticles, cortice, and a medulla. A cortex occupies most of a hair shaft and is composed of macrofibrils. Furthermore, a macrofibril is composed of microfibrils and matrix proteins. These microscopic structures of a cortex are considered to be related to a degree of macroscopic curl of hair. In case of human hairs, degrees of curl have racial and individual variations. Naturally curly hairs often cause distress to those who want their hair to be straight, and besides, they cannot be straightened unless they are treated by straight perming. Therefore, it is required to improve techniques of straight perming with a well-founded knowledge of the mechanism of curly hair structure. In this study, we performed small-angle X-ray scattering (SAXS) analysis of cross sections of naturally straight and curly hairs, and investigated differences in inner structures between naturally straight and curly hairs, as well as straight perming effects on inner structures of naturally curly hairs. SAXS experiments were performed at SPring-8 (Japan Synchrotron Radiation Research Institute). Transmission electron microscopy (TEM) observations were also carried out to investigate microstructures of hairs. The SAXS experimental results showed that the microfibrils of naturally curly hair are anisotropically aligned, whereas those of naturally straight hair are isotropically aligned. These results suggested that (1) cross-sectional alignments of the microfibril structures are different between naturally straight and curly hairs and (2) the alignment of straight-permed curly hair is close to that of naturally straight hair. Therefore, the alignment of microfibrils seems to be a key factor in macroscopic hair straightening.

Key words: X-ray, curly hair, microfibril, cortex, straight permanent.