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Structural Analysis of Curly Human Hair Single Fibers by Scanning Microbeam SAXS

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Introduction

Understanding the cause of hair curliness is one of major isuues in the cosmetics field. We studied the nanostructure of curly hair fibers, and detected the lateral inhomogeneity of the arrangement of the intermediate filaments (IFs) in the cortex, which was associated with the fiber curvature [1].

In this study, the correlation between the macroscopic curliness and the microscopic inhomogeneity of hair fibers of different curliness among three major ethnic groups has been investigated in detail.

Experimental

Chemically untreated human hair fibers of African, Caucasian and Asian, were used in this study.

Two dimensional SAXS patterns were measured with an X-ray microbeam (size: 5 μm). A hair fiber was moved in the transverse direction with a 5 to 10 μm step from outer (P=0) to inner (P=1) sides of the fiber curvature, where P represents the relative measureing position.

The center-to-center distance of IFs and the radius of IF were determined from the equatorial intensity profiles and full-width at half maximum (FWHM) of the intensity profile in the azimuthal direction was also evaluated [3]. FWHM relates to the IF tilt angle against the fiber axis.

Results and Discussion

Figures 1 and 2 show the values of FWHM obtained from curly and nearly straight hair fibers, respectively. To evaluate the lateraly inhomogeneious tendency of FWHM, the ratio of the average value of the outer part (P=0.2 to 0.4) to that of the inner side (P=0.6 to 0.8), η, has been calculated. The values of η after normalized by the hair fiber diameter, D, are plotted against the radius of curvature (ROC) in Fig. 3. It is concluded that the curliness of human hair has a strong correlation with the inhomogeneity of the IFs arrangement. Moreover, the correlation curve seems to be common for different ethnic origins.

References

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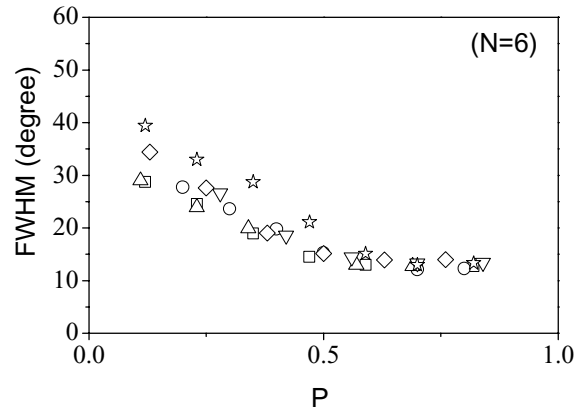
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Fig.1 FWHM (IF tilt anlge) vs normalized lateral position for curly Affrican hair fibers.
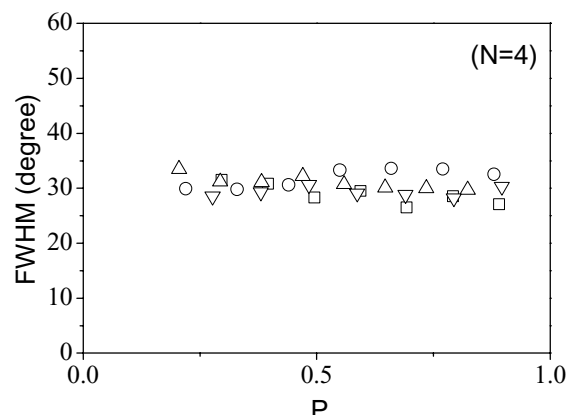

Fig.2 FWHM (IF tilt anlge) vs normalized lateral position for nearly straight Asian hair fibers.
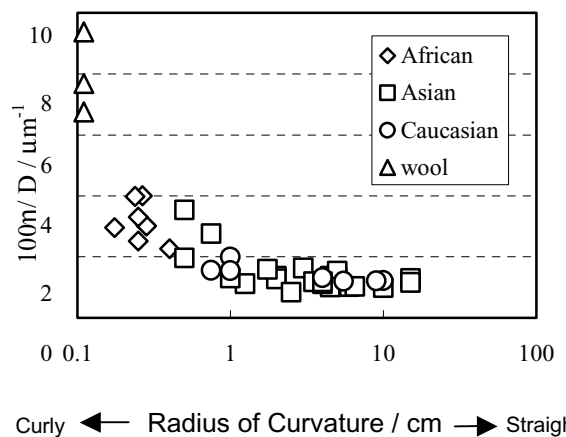

Fig.3 Correlation between the macroscopic curliness and the microscopic inhomogeneity of hair fibers.