Measurement Magic to Deliver Hair Beauty

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ABSTRACT

We developed the method to evaluate hair beauty in terms of hair volume and hair alignment for development of hair care products. Optical Sectioning Method (OSM) based on laser triangulation was applied to measure 3D images of hair samples, and difference of volume control and ability of hair management was sensitively distinguished among hair care conditioners, which 2D imaging could not achieve. Here we introduce you to the OSM to measure hair volume and amount of frizzy hair. .

Keywords: hair beauty, hair care, OSM, laser triangulation, 3D imaging, hair volume, frizzy hair

INTRODUCTION

Shine (Wenninger and McEwen, 1992), smoothness, ease of combing, decrease of split ends ((Robbibs and Reich, 1986) are the benefits demanded to hair conditioners (Idson B, 1983). In addition, the benefits related to styling such as manageability, volume control and frizz control have become more important to the Consumer. In the process of development of hair conditioners which were expected to deliver volume and frizz control, measurement of hair volume and frizz was strongly needed by formulators to confirm the benefit. Available methods to measure hair volume and frizz were based on 2D imaging and they were not sensitive enough to differentiate the benefit by different formulations.

Here we introduce you to the breakthrough method to sensitively measure hair volume and frizz based on 3D imaging, which was achieved by laser triangulation, so called as Optical Sectioning Method (OSM) (Bickel et. al., 1985).

DEVELOPING OSM SYSTEM TO MEASURE HAIR VOLUME AND HAIR FRIZZ

Hair Sample

Hair samples were prepared by randomly selecting hair fibers from the hair source which was commercially available (See Figure 1).

Each hair sample was treated with a conditioner after pre-wash process. Then each treated hair sample was exposed to high humidity and high temperature, to accelerate fly away hair.

OSM

Optical sectioning method based on laser triangulation was applied to reproduction of 3D images of hair samples. Figure 2 shows the optical arrangement of measurement of hair state. The hair sample is placed in front of a center plane (x-z plane at y = 0) at a position which is within the focal area of the light, and the position of the surface of the hair sample is the distance y of the surface of the hair sample from the center plane.

The line laser is scanned from hair tip to root, the reflected light from hair surface is detected by CCD, then the received light is converted to the distance/displacement by triangulation. The 3D image reproduction is done with the displacement data.

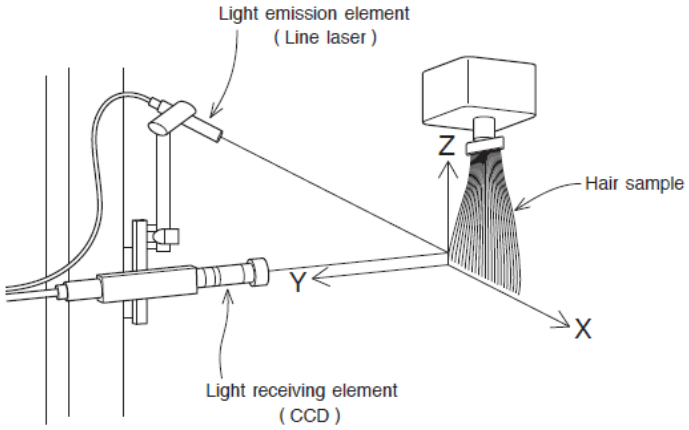
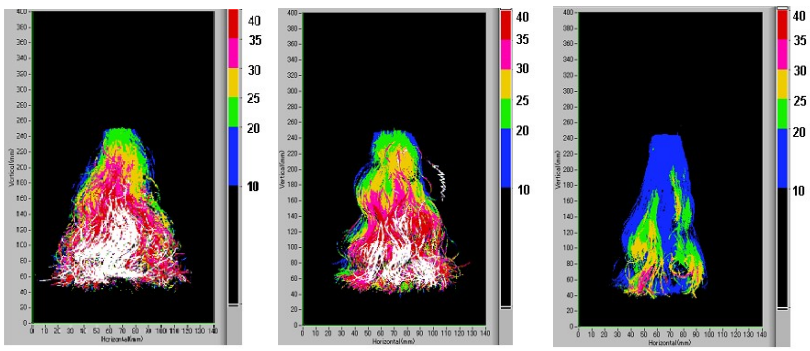


Figure 2 Optical Arrangement of the OSM system

COMPARISON OF PERFORMANCE OF HAIR CONDITIONER BY EVALUATION VOLUME CONTROL AND FRIZZ CONTROL

3D Images of Hair Samples

Figure 3 shows 3D images of hair samples treated with different conditioners. Hair fibers were color-coded by displacement from the center plane (x-z plane at y=0). In the images, hair fibers in white color are displaced from the center plane most largely, meaning most flying away.



A B C

Figure 3 3D Images of hair samples treated with different conditioners

Hair Volume

For the evaluation of the overall hair volume, the hair sample was scanned in whole, i.e., from root to tip and from right side to left side. The volume was calculated with reproduction of the structure of the hair sample in three dimensions.

Figure 4 shows the comparison of volume among three different treatments. Clearly the performance of volume control is differentiated.

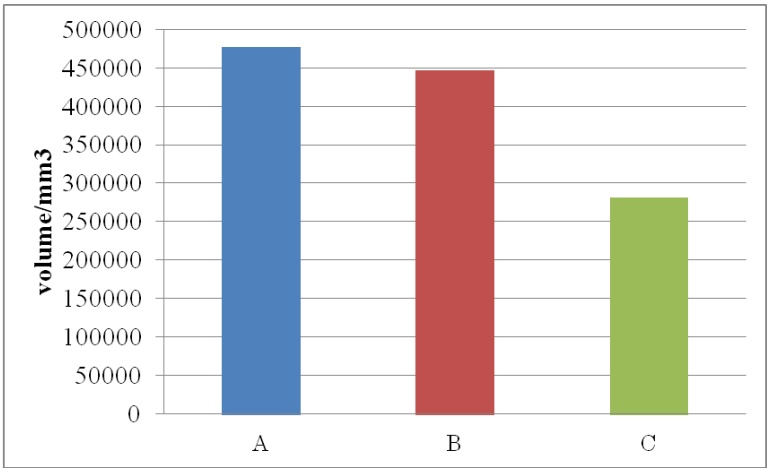


Figure 4 Comparison of hair volume among different treatments

Hair Frizz

Based on the same measurement with the volume evaluation, frizz amount was also obtained (see Figure 5). Here, the horizontal axis shows the distance y which is a distance of the surface of the hair sample from the center plane, and the vertical axis shows the percentage of hair volume compared to the hair volume at y=10. The ratio of the volume in % is taken as frizz amount. At y= 30 or more, Sample A shows a larger percentage, i.e., larger amount of hair volume compared to Samples B and C. Larger amount of hair volume at a certain distance such as y=30 or more means expanded hair and/or hair which is not aligned well, i.e., larger amount of frizz. Sample C which shows the smallest % at y=30 or more has the best frizz control performance.

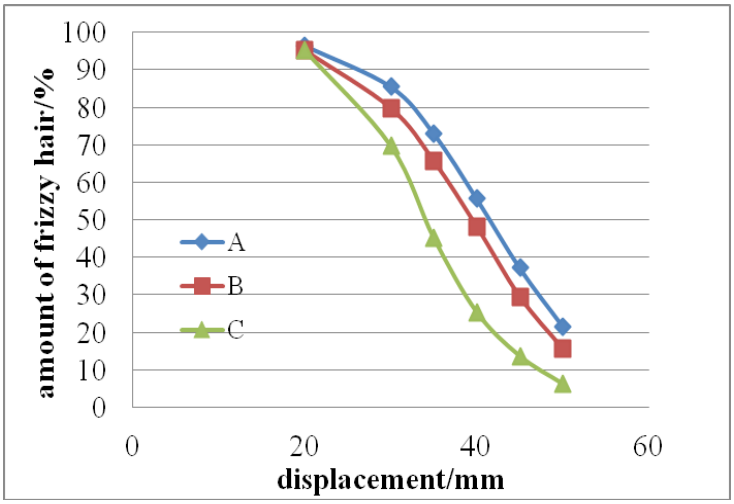


Figure 5 Amount of frizzy hair by increasing y from center plane

CONCLUSIONS

3D imaging based on optical sectioning method allowed us to measure hair volume and frizz amount. It was sensitive enough to differentiate the performance of conditioners, which had never been achieved by 2D imaging.

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