MILBON

News Release

September 14, 2015

A Global First: The Discovery That The “Dual Structure of Protein Density” Inside Hair Changes With Age

The Milbon Co., Ltd. (President and CEO: Ryuji Sato) has, through research using the SPring-8 Synchrotron Radiation Facility[*1], discovered a “dual structure of protein density,” in which the density of protein differs inside hair between the outer edge and its interior. Furthermore, we have confirmed for the first time in the world that the inside of the hair of women with roots that have started to lie flat due to advancing age displays an uneven breakdown of this dual structure. Milbon intends to apply this discovery to hair care products to be released in spring next year. We have announced these research results externally as follows.

[External Release]

Released At: Tokyo University of Science, Yamaguchi　234th Colloquium

Release Title: "Development of Hair Products Using Synchrotron Radiation ~ Investigation into the Internal Composition of Hair Using Synchrotron Radiation ~"

Released By: Kosuke Watanabe, Ryosuke Yamanaka, Kazuyuki Suzuta, Takaaki Maeda, Len Ito

Released On: September 11, 2015

[Research Background]

It’s said that one important element required for beautiful hair styling is for the roots of the hair to stand straight up. It has already been understood that, with advancing age, factors such as hair losing volume and strand count being reduced make it harder for the roots of hair to stand up. While researching this phenomena, interviews with beauticians revealed that in many cases hair starts to lie down from the roots and in the direction of hair flow prior to these changes due to age starting to occur, (fig.1). The reason for roots starting to lie down in this fashion was unknown, and there was no reported way to prevent it. Milbon therefore set about researching the cause of hair roots starting to lie down in this fashion.

[Research Results]

~ Discovery of the “Dual Structure of Protein Density” ~

The roots of the hair of 10 women with roots that stand straight up were examined via the microscopic FT-IR method[*2], using the SPring-8 Synchrotron Radiation Facility. It was indicated by the strengths of the peaks in the Amide III Band[*3], known to indicate protein, that protein density in hair is higher in the outer interior edge than it is the rest of the interior, (fig.2). This indicates that a region of denser protein exists in the outer interior edge of hair, and indicates the existence of a “dual structure of protein density.”

~ Roots Starting to Lie Down and the Breakdown of the Dual Structure ~

When the hair of 10 women with roots that have started to lie down was examined using the same methods, a difference from the hair with standing up roots was confirmed; an uneven breakdown of the dual structure of the protein, (fig.3). These results led us to conclude that this uneven breakdown of the dual structure in accordance with advancing age is one of the factors that causes roots to start lying down.

~ New Discoveries Made by This Research ~

While microscopic FT-IR and other methods have been used in the past to acquire information on the interior of hair, there are no recorded examples of confirmation of the existence of a dual structure of protein density inside hair or that changes in this density occur with age.

[Further Plans]

The use of SPring-8 to analyze the density of protein inside hair has allowed us to identify a new factor at the molecular level in regard to the changes that occur in hair with age. Furthermore, we have identified an effective method of care for these age-induced changes. In regard to our understanding of the dual structure of protein inside hair and methods of care relating to it, we intend to make the following external releases.

[Planned External Releases]

Released At: The Society of Fiber Science and Technology Fall Research Symposium 2015
Release Title: “Investigation into components distribution in hair using infrared microscope”
Released By: Kosuke Watanabe, Ryosuke Yamanaka, Kazuyuki Suzuta, Takaaki Maeda, Len Ito
Released On: October 22-23, 2015

Released At: The 67th Annual Meeting for the Society of Biotechnology, Japan
Release Title: "Age-related change of components distribution in Japanese woman’s hair using infrared microscope”
Released By: Kosuke Watanabe, Ryosuke Yamanaka, Kazuyuki Suzuta, Takaaki Maeda, Len Ito
Released On: October 26, 2015

Person With Roots Standing Up

Person With Roots Starting to Lie Down

Fig.1 Differences in Roots Standing Up

When roots start to lie down, parting and hair whorl become more pronounced, having a detrimental effect on hair styles

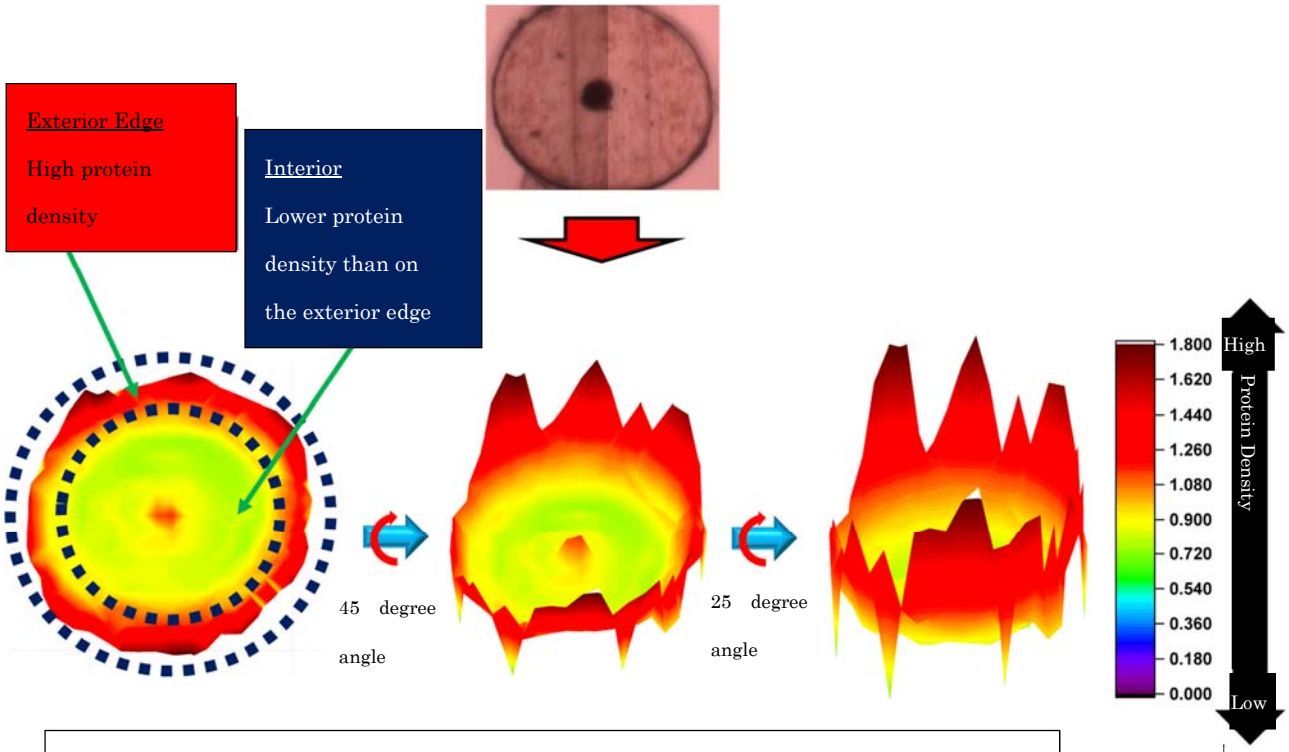


Image of hair root rendered in 3D through analysis of SPring-8 microscopic FT-IR data

*Typical Example

Fig.2 Comparison of Amide III Peak Surface Area Inside Hair

It was discovered that the outer edge of the interior of hair has a higher protein density than the interior, creating a dual structure

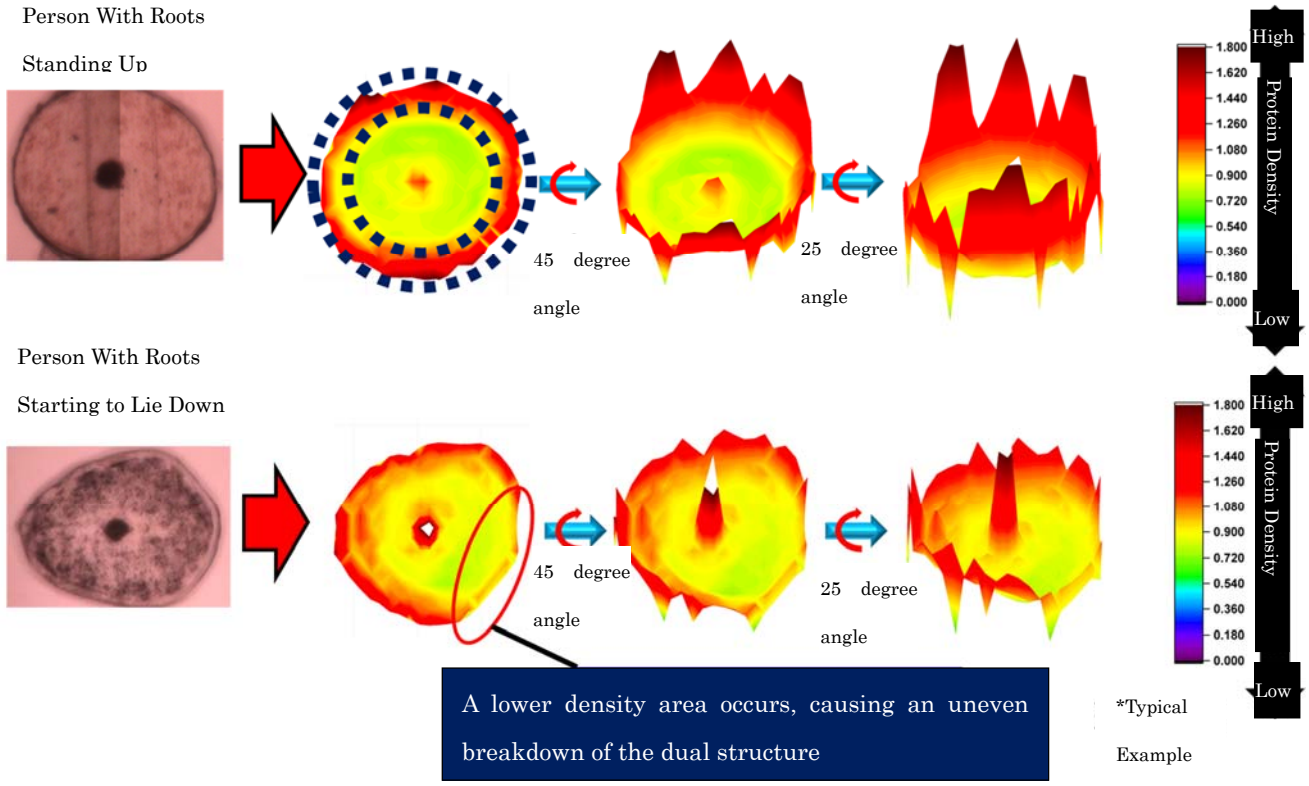


Fig.3 Relationship between Roots Starting to Lie Down and Uneven Breakdown of Dual Structure

It was discovered that people with roots that have started to lie down have an uneven breakdown of the dual structure of protein in their hair.

Part of this experiment is uses results from the Japan Synchrotron Radiation Research Institute (SPring-8/JASRI) industrial use general research 2015A1654.

<Terminology>

*1 SPring-8 Synchrotron Radiation Facility

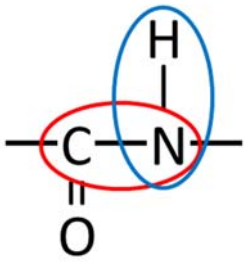
A Riken managed facility capable of producing the highest levels of synchrotron radiation in the world, located in the Harima Science Park City, Hyogo Prefecture. There are only two comparable facilities in the world, one in America and one in Europe. The name SPring-8 is taken from the full name of the facility, the Super Photon ring-8 GeV. Synchrotron radiation is the name given to the powerful electromagnetic waves generated when electrons are accelerated to almost the speed of light and then their direction of travel is altered using magnets. At SPring-8, this synchrotron radiation is used in a wide range of research, including into nanotechnology, bio-technology and manufacturing.

*2 Microscopic FT-IR Method

The “microscopic FT-IR method” refers to the “microscopic Fourier Transform-Infrared Spectroscopy method,” an analytical device that is used to determine the composition of compounds. Molecules are exposed to infrared rays, during which the vibrational energy between the atoms comprising those molecules absorbs a certain amount of those rays. Measuring the volume absorbed therefore allows the composition of the compound to be established. The microscopic FT-IR method is an especially effective means of performing analysis in the microdomain, a scale at which the normal FT-IR method cannot obtain any measurements. This procedure is applied in a variety of different fields, including quality control of a range of industrial products, scientific investigation and biomedical composition analysis.

*3 Amide III Band

From among the peaks acquired from hair using infrared spectroscopy, the Amide III Band is the peak in the vicinity of 1240 cm^{-1} that expresses the C-N stretching vibration (inside the red circle on the diagram below) and the N-H bending vibration (inside the blue circle on the diagram below) of the peptide bonds found inside protein.



Peptide Bond

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