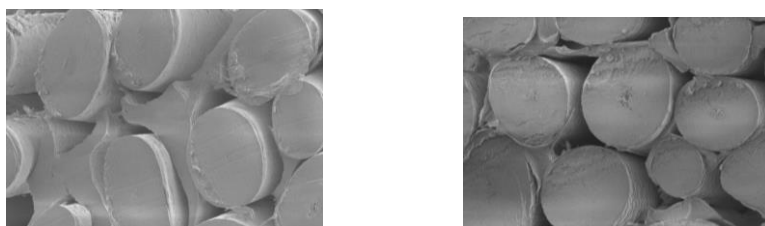


Press Release

## Shiseido Develops Two Approaches to Correct the Cross-Sectional Shape of Hair

~Restoring hair vitality and creating manageable glossy hair~

Shiseido Company, Limited (Shiseido) has discovered that the distortion and flattening in the cross-sectional shape of damaged hair will be further deteriorated through the daily routine of shampooing and drying, and successfully developed two methods that correct and restore such distortion and flattening in the cross section of damaged and frizzy hair. Shiseido will leverage each technology into further development of haircare products for both professional and general home use.

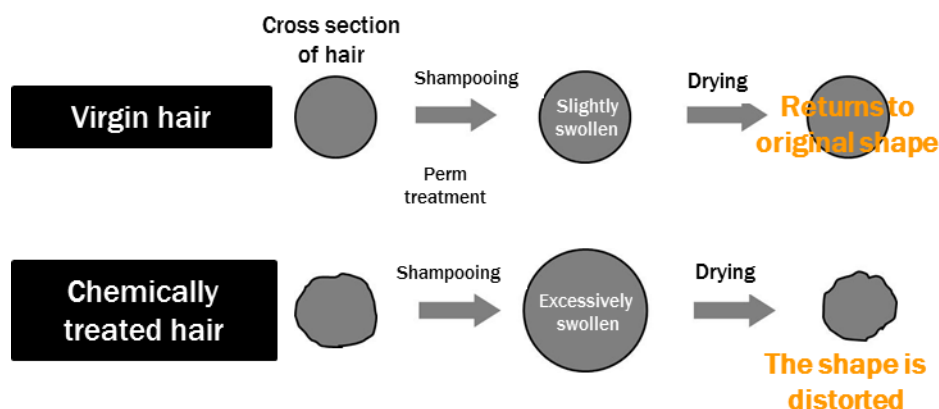


Picture 1. Repairing flattened hair (electron micrographs of hair cross section).

Left: Cross-sectional shape of frizzy hair: Flattened. Right: Flattening reduced with GA, GDL and thermal treatment.

### Changes in cross-sectional shape of damaged hair

Conventional hair care methods for damaged hair mainly approached cracked cuticles on the hair surface or the inside structure such as porous hair. In the meantime, Shiseido focused on the distortion in cross-sectional shape of a single hair and has found out that a hair damaged by chemical treatments such as perming swells easily when it gets wet, e.g. by shampooing, and then its cross-sectional shape will be further distorted as it shrinks when it dries.



Picture 2. Mechanism of distortion in cross-sectional shape

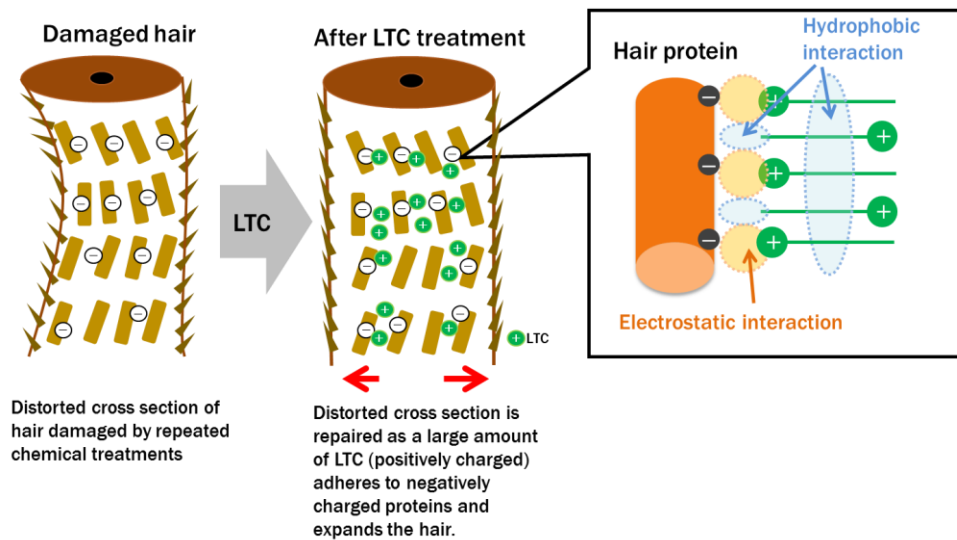


Picture 3. Cross sections of virgin hair (left) and damaged hair (right).

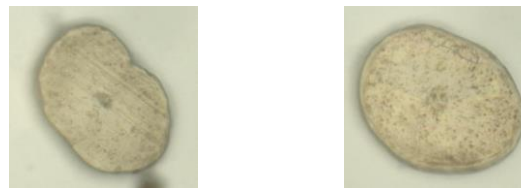
Cross section of hair damaged by repeated chemical treatment is distorted like that of frizzy hair, and will be further deteriorated by repeated shampoo and drying.

### Approach 1: Discovery of a new function of lauryl trimethylammonium chloride (LTC)

Shiseido has discovered that lauryl trimethylammonium chloride (LTC), which is one of cationic surfactants, is effective in repairing distorted cross-sectional shape of hair by expanding it from the inside.



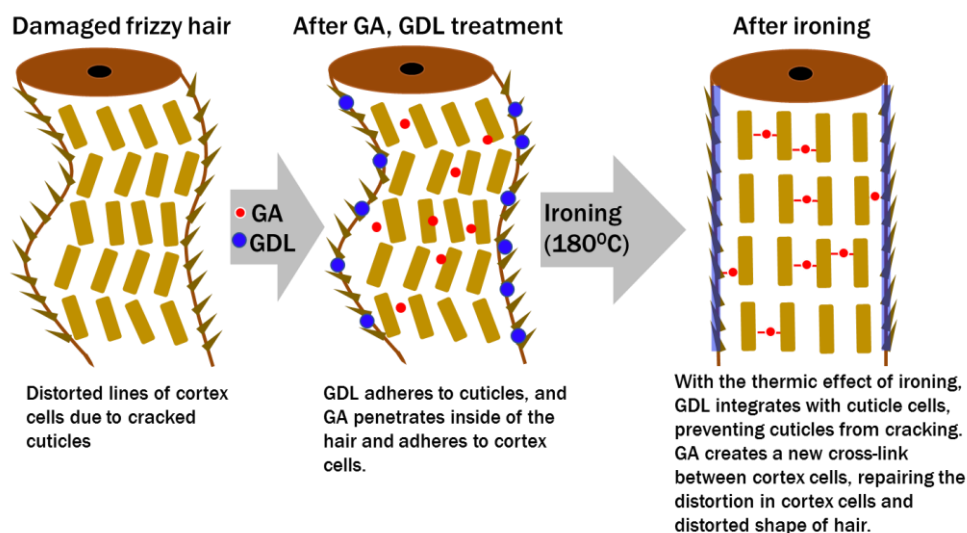
Picture 4. Mechanism of shape restoration with LTC (image)



Picture 5. Optical micrograph of hair cross section.  
Without (left) and with LTC treatment (right)

### Approach 2: Development of a new technology using glyoxylic acid (GA)

It has been known that glyoxylic acid (GA) has a straightening effect on hair fibers, modifying hair cross sections when it is used alone at a strong acidity of less than pH2.0. At the same time, there was a concern that it could further damage hair and scalp. This time, Shiseido has clarified that by combining GA with glucono- $\delta$ -lactone (GDL) at a specific concentration and applying thermal treatment, GA demonstrates the same effect at a weak acidity of pH3.0 ~ 3.8. GA also works on the distortion in cross-sectional shape of hair, largely contributing to improving the texture of damaged hair.



Picture 6. Mechanism of shape restoration with GA, GDL and thermal treatment (image)



Picture 7. Optical micrograph of hair cross section.

Without (left) and with GA, GDL and thermal treatment (right)



Picture 8. Effect of GA, GDL and thermal treatment (with LTC treatment to finish).

Before (left) and after treatment (right). Creating a smooth lustrous texture.

#### Future application of these technologies

While GA requires professional treatment, its shape restoration effect lasts for about one month. On the other hand, LTC can be used for treatment simply and repeatedly. Thus, Shiseido is planning to apply GA to the development of professional salon products, and LTC — to hair care products for home use.