Penetration evaluation of the chemical agent to the hair using NanoSIMS

NanoSIMS 50L possesses the highest lateral resolution among SIMS, as well as high mass resolution. Here, we introduce an example of penetration evaluation of the chemical agent as imaging of cross section of the hair penetrated by a stable isotope (deuterium) labelled compound.

Feature of NanoSIMS 50L

[Equipment specs]

Primary ion beam	Cs^+, O^-
Minimum beam diameter	O^-: < 50 nm Cs^+: < 50 nm
Limit of detection	ppb ~ ppm
MS spectrometer	Double focusing
Simultaneous detection number of Ions	7
Analysis depth	<several tens of nm

[Image of the instrument]

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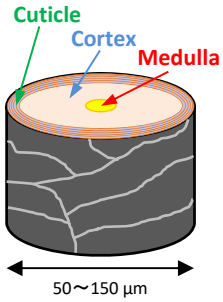
High lateral resolution, high mass resolution and high sensitive mass images can be acquired by NanoSIMS.

Structure of human hair



- Human hair is composed of 3 parts which named cuticle, cortex and medulla, respectively.
- Cuticle is mainly composed of keratin which is a protein including much sulfur.
- 6 to 10 cuticle layers is stacked.

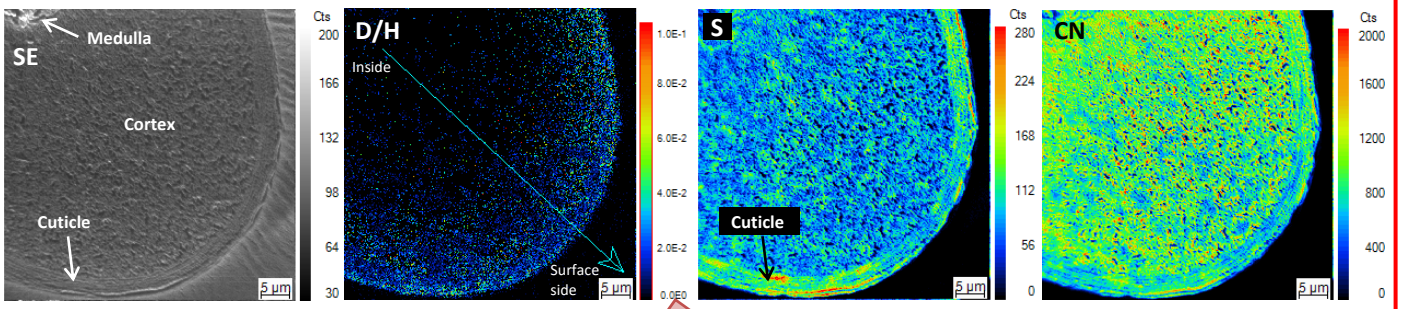
NanoSIMS is useful for the detailed evaluation of penetration state of hair conditioning agents or dyes.

Imaging of cross section of the hair

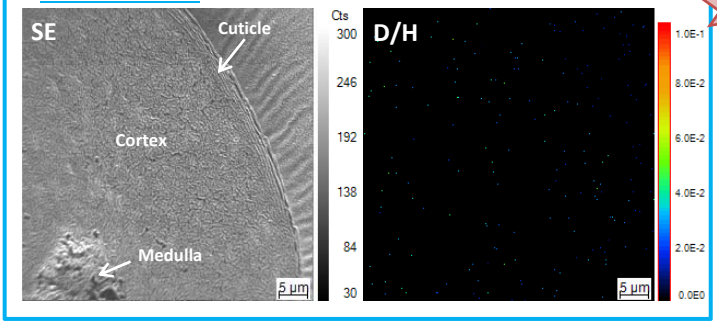
Sample : Hair of an adult male Model chemical agent : Deuterium labelled sodium dodecyl sulfate (D-SDS) ----> $CD_3(CD_2)_{11}OSO_3^-\ Na^+$

Pretreatment : Soak the hair in 10 wt% D-SDS solution for 24 h ⇒ Air-dry ⇒ Wash ⇒ Make cross section ⇒ NanoSIMS

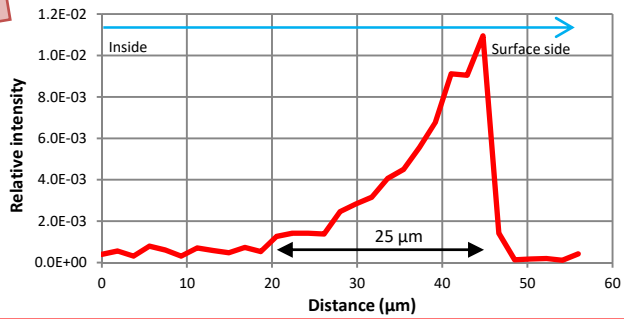
D-SDS treated hair



Untreated hair



We made a line profile along the blue arrow of the image.



✓According to the D/H image, it was observed that D-SDS penetrate the hair.

✓According to the line profile, we infer that the penetration depth of D-SDS is approximately 25 μm from the surface.

We provide penetration evaluation of the chemical agent labelled by a stable isotope (ex. D, ^{13}C, ^{15}N, ・・・).