

Processes of oxidation and Ca accumulation in human hair observed by X-ray contact spectromicroscopy and X-ray fluorescence mapping

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Introduction

Possible correlation between Ca content in human hair and the incidence of human breast cancer has been suggested [1]. However, Ca content was also demonstrated to increase with the treatment of an oxidative colorant [2]. Therefore the contribution of oxidative damage to the increase of Ca content in human hair should be evaluated in more detail. In combination with X-ray spectromicroscopic imaging of cysteine, an oxidation product of cystine [3], and X-ray fluorescence mapping of Ca, we have shown the close correlation between the increases in production of oxidative damage and the Ca accumulation for untreated and bleached hair [4, 5].

In the present study, we observed the oxidation process of human hair with controlled bleach treatment using oxidation reagents and directly compared to the process of Ca accumulation.

Materials and Methods

For the mapping of cysteine, X-ray contact microscopy with an electronic zooming tube with a resolution of about 0.5 μm was employed at the S-K edge at BL-11B. Analysis of Ca distribution was carried out by X-ray fluorescence mapping at BL-4A.

For the artificial bleaching in the laboratory, hair specimens from normal women were soaked twice in a solution containing 1.2% ammonia and 3.5% hydrogen peroxide for 5 min, 15 min, 30 min, 1 hr and 3 hrs. Ca soaking was performed with 10 mM CaCl_2 for 2 days with a daily change of the solution. At the position of around 1 cm from hair roots, they were cut at the thickness of about 20 μm , and then placed on a SiN membrane with 100 nm thickness. The opposite side of the membrane was coated with Au as a photocathode of the zooming tube.

Results and Discussion

Fig. 1 shows X-ray absorption images of cystine, cysteine acid and Ca in Ca-soaked hair after various treatment time of the bleaching. In accordance with the increase of cysteine acid by the bleaching, Ca content was also found to increase as expected from our previous results [5]. Oxidation and Ca accumulation were found to start from the peripheral area, cuticle, and to extend to the whole area. Note that Ca accumulation in the central area,

medulla, seem to be independent of oxidation treatment as shown in the panels (b), (c), and (d).

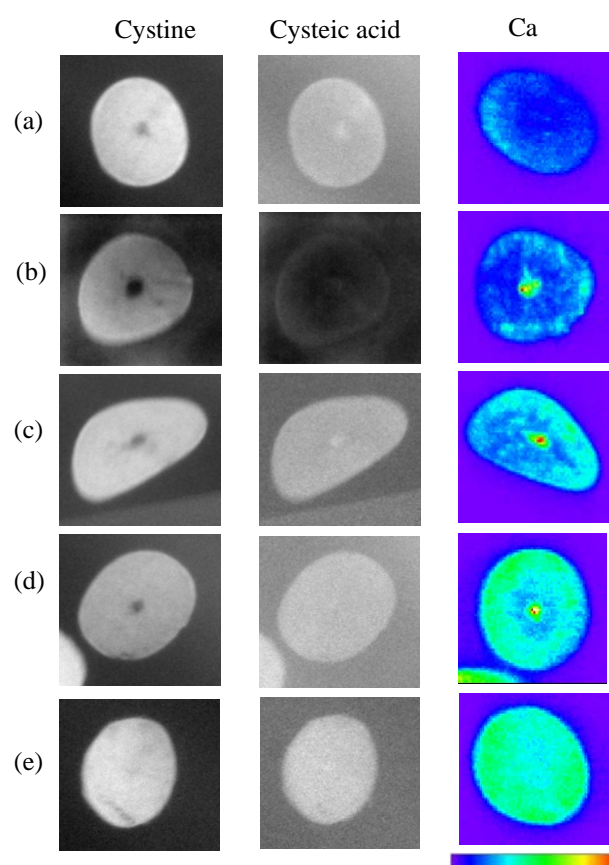


Fig. 1. Cystine, cysteine acid and Ca distributions in Ca-soaked human hair after bleaching with various treatment time. (a) 5 min, (b) 15 min, (c) 30 min, (d) 1 hr, (e) 3 hrs.

References

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