Investigations of the time-dependence of pH-changes in human hair

Document Version
Final published version

Link to publication record in Manchester Research Explorer

Citation for published version (APA):

Citing this paper
Please note that where the full-text provided on Manchester Research Explorer is the Author Accepted Manuscript or Proof version this may differ from the final Published version. If citing, it is advised that you check and use the publisher's definitive version.

General rights
Copyright and moral rights for the publications made accessible in the Research Explorer are retained by the authors and/or other copyright owners and it is a condition of accessing publications that users recognise and abide by the legal requirements associated with these rights.

Takedown policy
If you believe that this document breaches copyright please refer to the University of Manchester’s Takedown Procedures [http://man.ac.uk/04Y6Bo] or contact uml.scholarlycommunications@manchester.ac.uk providing relevant details, so we can investigate your claim.
This research was carried out, first, with the objective to monitor and model the time-dependent H⁺/OH⁻ uptake of human hair in different pH environments. Second, changes to the hair due to ion uptake were investigated using Modulated Differential Scanning Calorimetry (MDSC) in water.

For the investigation H⁺/OH⁻ ion uptake of untreated, commercial, Caucasian hair from solutions of defined initial pH (liquor ratio 1000:1 or 100:1) were investigated over the experimentally accessible pH-range and for a period of 24 hours. The change in solution pH over time was monitored and converted to ion-uptake. It could be shown that the changes follow in all cases a 1st-order kinetic model between two limiting values. In the acid region, characteristic times for the H⁺ -uptake are largely independent on pH and about 2 – 3 hours. In the alkaline region, the equivalent OH⁻ -uptake occurs by an order of magnitude faster. Equilibrium values for ion-uptake for the pH-range were determined from the model fits.

DSC measurements in water yield the keratin denaturation enthalpy ΔH_D, which relates to the thermal stability of the keratin intermediate filaments (KIFs), and the denaturation temperature T_D, which depends on the properties of the keratin associated-proteins (KAPs). To determine potential effects of dialysis during the DSC experiment, a methodology was developed to apply low liquor ratios down to 1:1. The results show the significance of liquor ratio in the DSC-pans. An increase of T_D is observed at pH1, compared to the untreated hair, which steadily decreases as pH increases to 11. The change to ΔH_D is negligible in this pH-range. However, when the low liquor ratio is employed in the DSC-pans, an increase is seen at low pH. Only beyond pH 12 an increase in T_D and a decrease in ΔH_D are observed, which are attributed to lanthionine crosslink formation in the matrix and pH-induced thermal instability of the helical sections in the filaments.