Hair Analysis Before and After Thermal Treatment Employing DSC - A Forensic Approach.

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Abstract

In this study, differential scanning calorimetry (DSC) was used to analyze hair thermal degration.

Introduction

Human hair is a very important source of micro traces in forensic analysis. This biological material may provide, for instance, a history of products consumed by a person in a certain period from days to months preceding the collect.[1] Gas chromatography mass spectrometry (GC-MS) is an efficient technique already used in the analysis of hair quantifying composts in the sample; however, this method is very expensive to be made repeatedly and routinely. The DSC can be used as auxiliary analysis with forensic importance. In special, the DSC with heat flow presents curves showing the exothermic peaks represent endothermic events and events in the same analysis, possibly a viable alternative for the analysis of hair.[2] Therefore, overlooking the possibility of identifying and determining the ethnicity of the individual observing the overlapping curves obtained, results to a database, this study proposes an analysis of the natural Asiatic/Mongolic hair by DSC before and after chemical treatment.

Results and Discution

The samples used were collected previously from local students through extraction of a strand of hair from the front head region. Afterwards, the hair was washed with a mild shampoo, distilled H_2O and subsequently dried at room temperature. In addition, about 2 mg were placed in crucibles closed Aluminum (Al) and set to DSC 200 F3 Maia with a temperature range from 20 and 600 °C in atmosphere of N_2 (gas of purge).

Later, in an analysis of the graph obtained via DSC for natural hair, it was possible to observe the occurrence of similar events in the same temperature range for hair of three different individuals, however, from the same ethnicity, showing a commitment condition (connection) between ethnicity and individuals (Fig. 1).

Relating to the evaluation of hair that suffered heat treatment, a protein denaturing was noticed, observing from a simple evaporation of H_2O up until a loss of protein which constitute the hair fiber. Comparing hairs with and without heat treatment, it can still be observed at certain temperatures, some events continuing to occur in natural hair and treaties. Thus, although the possibility of protein loss, it was still possible to identify an ethnicity through analysis by DSC.

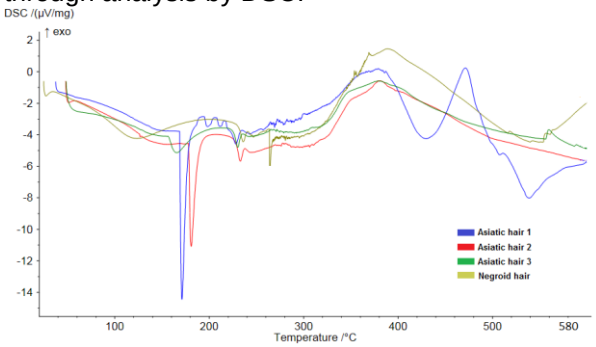

Figure 1. Asiatic and Negroid hair degradation profile for DSC in large range of temperature.

As can be seen in Fig. 1, the DSC curves for Asian hair exhibit endothermic peak between 160 and 180 °C, which are attributed to loss of H_2O. Since the Negroid hair, which has a greater drying characteristic, has not changed in this range and temperature (Fig. 1).

At temperatures of 260 to 310 °C, it is seen in the analysis of Asian hair, the presence of small endothermic peaks attributed to denaturing keratin.

However in Negroid hair, this peak was higher and may be related to the uneven distribution of the hair's keratin or different connections of dissulfide bridges. The damaged Asian hair analyzed followed a standard curve with events in different temperatures.

Conclusions

Until now, it can be observed that at first DSC showed up to be a fairly rapid and inexpensive analysis technique as compared to the GC-MS, and can be used in forensic analysis and deployed for an analysis database.

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