



### **B148 The Investigation of Potential Mechanisms for the Formation of Postmortem Hair Root Bands: A Detailed Microscopical and Ultrastructural Analysis**

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After attending this presentation, attendees will better understand the microscopical and ultrastructural changes associated with hair displaying a Postmortem Root Band (PMRB).

This presentation will impact the forensic science community by explaining how this research investigates potential mechanisms for the formation of PMRBs. These results may help establish a more scientifically rigorous framework in which to discriminate between hair with PMRBs and antemortem hair with similar microscopic characteristics.

A PMRB is a distinct microscopic feature that occurs in the pre-keratin region of anagen and early catagen hairs derived from deceased individuals.<sup>1,2</sup> The appearance of this dark band has been shown to be the result of diffuse light scatter at the interface between the cells of the hair shaft and large elongated gas-filled void spaces.<sup>1</sup> The presence of these void spaces is the underlying basis for the observed PMRB.

The recognition of root banding in hair evidence can potentially provide valuable information concerning crime scene reconstructions; however, interpretations of PMRBs have recently been challenged in two high-profile criminal court cases.<sup>3,4</sup> One of the underlying issues used to question the validity of interpreting hairs displaying PMRBs is that the mechanism of band formation is not known. To help shed light on this issue, several recent studies have investigated the potential to produce the characteristics of PMRBs in antemortem head hairs through various environmental conditions.<sup>5-8</sup> Two of these studies report that some characteristics of PMRBs can be reproduced by environmental factors; it is cautioned that inexperienced hair examiners may falsely identify an environmentally degraded hair as a hair displaying a true PMRB.<sup>6,7</sup>

The goal of this research is to investigate the potential mechanism for the formation of PMRBs. A better understanding of this mechanism is essential to establish a more scientifically rigorous framework in which to discriminate between hairs with PMRBs and antemortem hairs with similar microscopic characteristics. In this study, detailed observations were made using high-resolution images of ultramicrotome sections of head hairs with known PMRBs. Microscopical analysis of the banded regions indicate that the appearance of the PMRB is due to the degradation of the chemically and mechanically labile, non-keratin Intermacrofibrillar Matrix (IMM) in the pre-keratin region of anagen hairs. In addition, PMRB formation is confined to the cortex region of the hair shaft; there is no observable damage to the layers of the cuticle even at ~50,000x magnification.

In an attempt to further investigate potential mechanisms of PMRB formation, antemortem anagen head hairs were subjected to several conditions (e.g., pH series, protease digestions, buffer solutions) that may affect the IMM. The results from these *in vitro* studies indicate that some microscopic characteristics of PMRBs can be replicated. This is most readily demonstrated when anagen hairs are subjected to slightly alkaline (pH 7-8) aqueous ammonium salt solutions. The banding that forms in these hairs appears, at both the light microscope and scanning electron microscope scale, to be very similar to PMRBs. Ammonium and ammonia are viable causative agents because concentrations of these compounds increase rapidly in the decomposing body due to degradation of protein through various autolytic and bacterial processes.<sup>9</sup> These results provide valuable insights that may assist in uncovering the mechanism for the formation of PMRBs.



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## References:

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## Postmortem Hair Root Band, Hair Microscopy, Trace Evidence