

## Two Optical Techniques for Observing Hair Cuticles in the Classroom

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Cuticular scale patterns of hair serve a variety of forensic purposes, such as distinguishing human hair from animal hair and from natural and artificial fibers [1, 2]. In addition, many hair care products that target the cuticle for repair, coloring, or conditioning leave identifiable traces [3]. Thus, the examination of cuticular scale patterns touches upon topics that interest a broad spectrum of students.

For optimal examination of hair by light microscopy, the observer must choose between examining either the cuticle (outer surface) or the interior of the hair. For example, the cuticle is best viewed as an air mount, i.e. without histological processing or the use of mounting media and cover slips, because the refractive indices of mounting media (1.5 to 1.55) are similar to those of hair (1.543 to 1.554) and obscure the surface features [2]. By comparison, the internal features of hair are more clearly visible when viewed as whole mounts (mounting medium and cover slips [2]).

In the present experiment, a Nikon microscope (Optiphot2-POL) was used for both transmission and incident (epi) illumination. Each illumination mode was used separately for examining and comparing the appearance of the hair cuticle using the air/dry mounted techniques of Crocker [1] and Evans [4]. First, Crocker examined the cuticle using transmission illumination. He affixed hair to microscope slides with two-sided transparent tape [1]. Second, Evans taped the ends of the hair to a front surface mirror and observed the cuticular patterns with incident illumination [4]. In the present experiment, aluminum foil (shiny side up) substituted for Evans' use of a front surface mirror [4]. The aluminum foil was affixed to the slide with two-sided tape.

The present study confirmed and extended the two aforementioned techniques. First, Crocker developed a simple, rapid, and effective method for examining the cuticle [1]. As shown in Figure 1, the technique works best for lightly colored hairs with narrow medullary cores. However, darkly pigmented hairs and hairs with large medullary cores obscured the overlying cuticular patterns [1]. In the present study, cuticular patterns of darkly pigmented hair and those with large medullary cores were visualized with varying degrees of success by adjusting condenser height and contrast. Second, cuticular features were readily visible when aluminum foil (shiny side up) substituted for a front surface mirror [4] as shown in Figure 2. In addition, epi illumination, when used without aluminum foil, revealed a diaphanous blend of both the cuticle and medullary core. Because Crocker's [1] and Evans [4] techniques are non-destructive, hairs can be reused and processed with other histological procedures.

How do the two techniques compare with each other and with cuticular casts? Crocker's technique is fast, simple, and reliable [1]. His technique works best for clear hair with relatively narrow medullary cores. As medullary cores widen, the central cuticle becomes proportionally less visible. In addition, cuticular patterns of pigmented hairs are difficult to observe. Evans' technique shows cuticular patterns clearly, but suffers from strong contrasts between the top of the hair and the sides. Unfortunately, epi illumination in upright microscopes is usually not available for routine classroom use. Cuticular casts, when properly performed, yield vivid cuticular patterns [5]. However, the casting technique requires

practice for consistency. In short, Crocker's technique is practical for the classroom because of its ease of use and high probability of success.

#### References:

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- [6] Supported in part by a Troy University Faculty Development Grant.

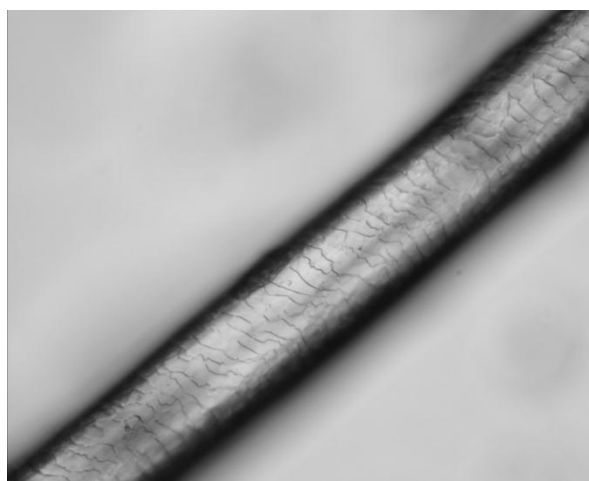


Figure 1. The appearance of human scalp hair using double-sided tape. Cuticular patterns are distinct. Dark shadows obscure the edges.

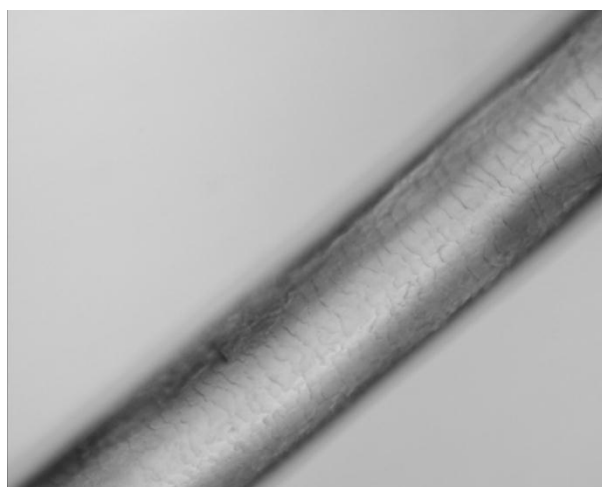


Figure 2. The appearance of human scalp hair using incident (epi) illumination. The cuticular patterns are distinct. Crown is slightly washed out. However, side shadows are not as strong as with transmitted light.