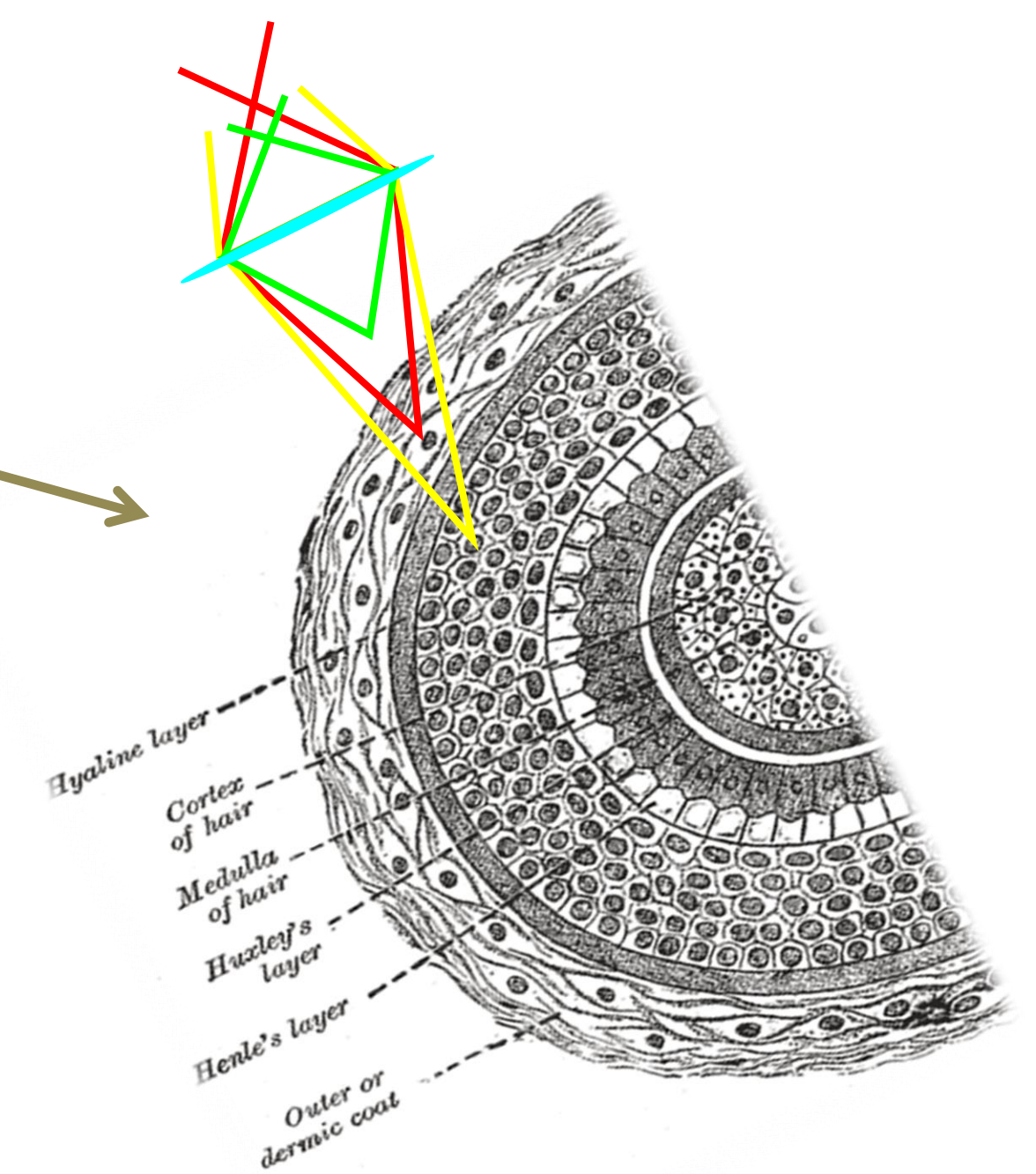
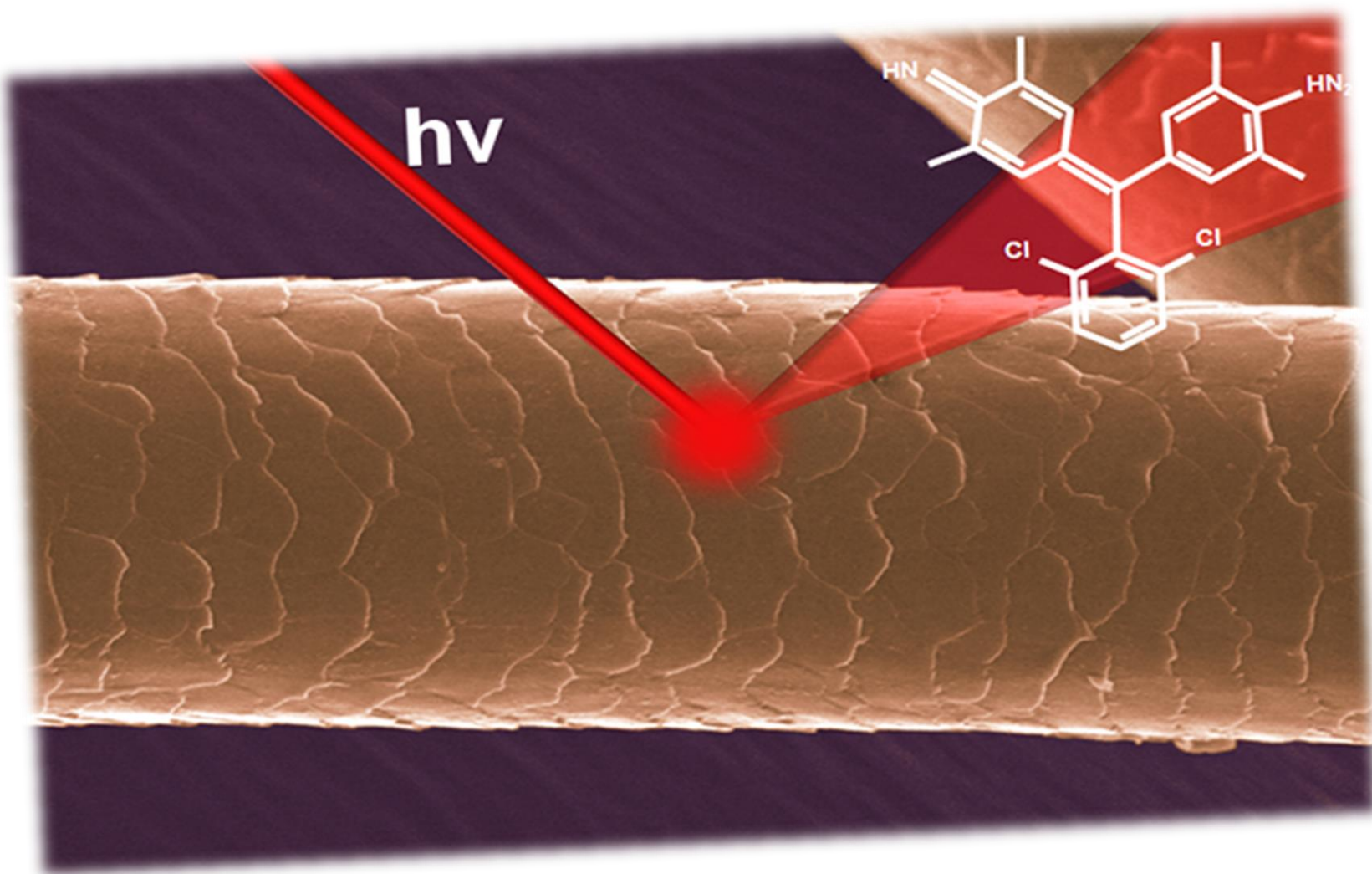
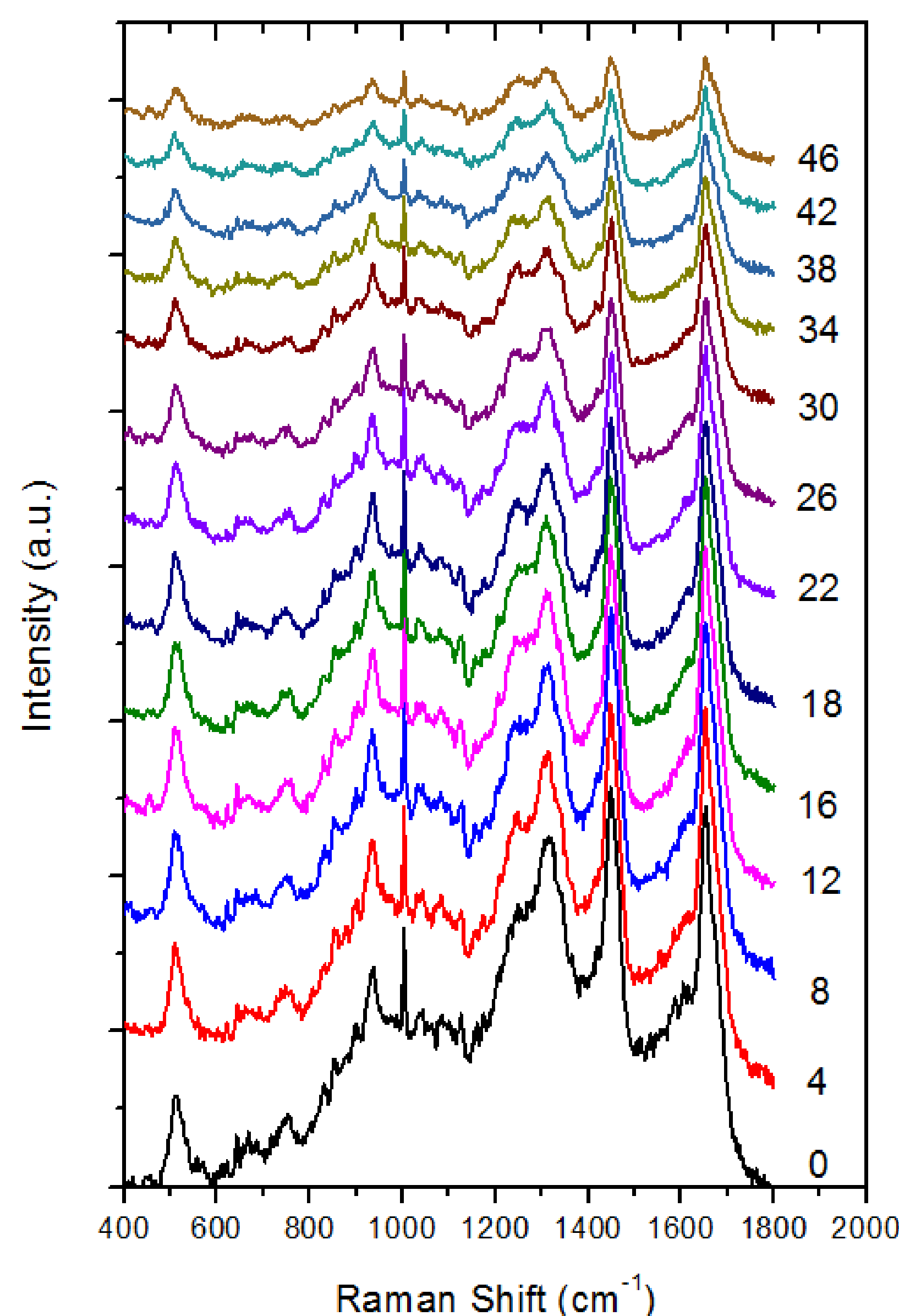


Hair analysis by confocal Raman spectroscopy

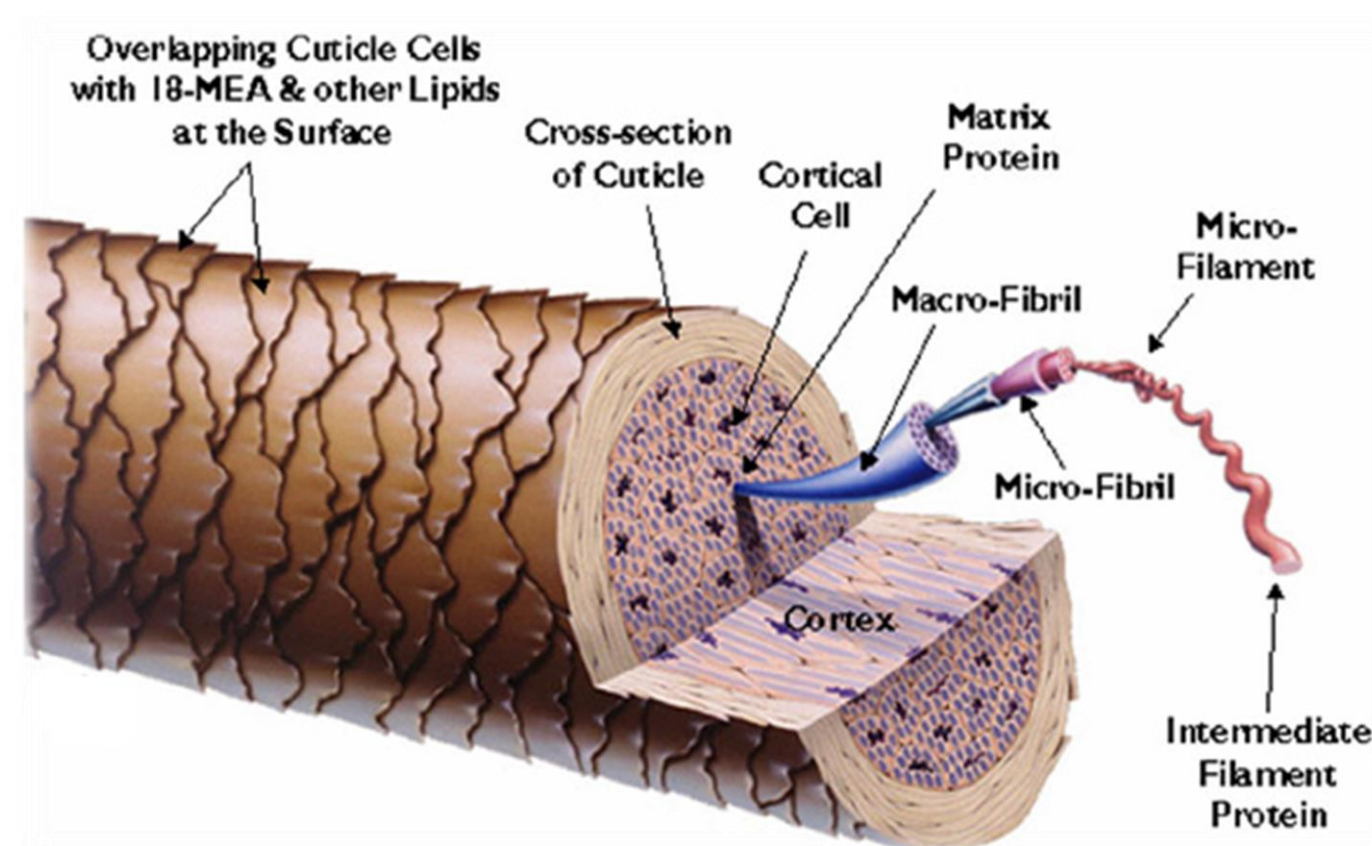
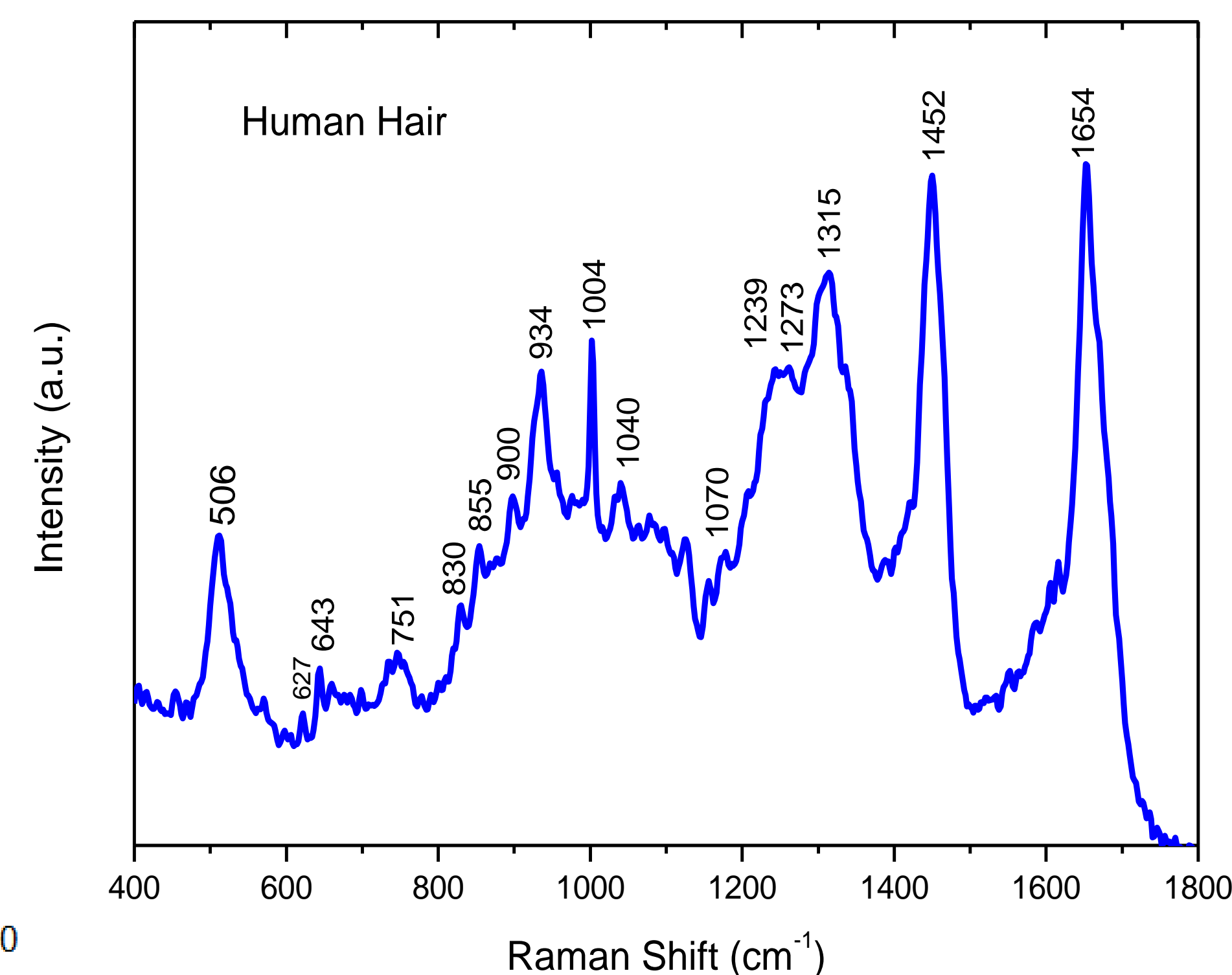
By confocal Raman, the physical sectioning of hair fibers is not required to obtain molecular chemistry and structure information within the fiber. This provides opportunities for the nondestructive examination of hair fibers under many different conditions.



Specific Confocal Raman data from untreated human hair describing the spatial dependence of lipid and protein distribution, protein secondary structure, lipid chain conformational order, and distribution of disulfide cross-links in hair protein are possible.



SO₂ is both IR and Raman active: 1040 (-S-O) and 1170 (SO₂) cm⁻¹ – monitor the degree of chemical oxidation of the fiber during chemical treatment



Raman spectra of hair fibers in spectral regions of 400 to 1800 cm⁻¹. Spectra were confocally obtained in 2 μm increments. Spectra are presented covering the cuticle, cortex, and medulla.

Raman data indicate that probing molecular structural changes in a specific region of hair will prove to be valuable tools in the understanding of hair structure, physiology, and the effect of various stresses upon its integrity.

wavenumber / cm ⁻¹	Assignments		
422	δ(CCC) chain	1209 (L)	ν(CC)/Tyrosine/Phenylalanine/amide III*
506 (L)	ν(SS) [trans-gauche-trans]	1239 (L)	δ(CH ₂) wagging/ν(CN)/amide III disordered
529	ν(SS) [gauche-gauche-trans]	1273	ν(CN)/δ(NH)/amide III (α helix)
540	ν(SS) [gauche-gauche-gauche]	1301 (L)	δ(CH ₂)
600 (L)	ρ(CH) wagging	1315 (L)	δ(CH ₂)
627 (L)	ν(CS) [gauche]	1391	δ(CH ₂) symmetric
643 (L)	ν(CS) [gauche]	1400	δ[(CH ₂) ₂] symmetric
741 (G)	ρ(CH ₂)	1425	δ(CH ₂)
751 (L)	ρ(CH ₂)	1452 (L)	δ(CH ₂) scissoring (lipid/protein)
830 (L)	δ(CCH) aliphatic/tyrosine	1534	δ(NH)
855 (L)	δ(CCH) aromatic/tyrosine	1556 (L)	δ(NH)/ν(CN)/amide II
880 (L)	ρ(CH ₂)/ν(CC)/ν(CN)/Tryptophane	1586 (L)	ν(C=C) ring
900 (L)	ρ(CH ₂)	1609	Phenylalanine/Tyrosine
934 (L)	ν(CC) helix α/ρ(CH ₂) terminal		ν(C=C) ring/
1004 (L)	ν(CC) ring/Phenylalanine	1616 (L)	Tyrosine/Tryptophane
1033 (L)	ν(CC) skeletal/cis	1654 (L)	ν(CONH) amide I α helix
1061	ν(CC) skeletal/trans	1677 (G)	ν(CONH) amide I β sheet
1081 (G)	ν(CC) skeletal/random	2565 (ns)	ν(SH)
1102	ν(CC) skeletal/trans	2732 (ns)	ν(CH) aliphatic
1128 (G)	ν(CC) skeletal/trans	2875 (ns)	ν(CH ₂) symmetric
1161 (L)	ν(CC)/δ(COH)	2931 (ns)	ν(CH ₃) symmetric
1177 (L)	ν(CC)	2966 (ns)	ν(CH ₂) asymmetric
1185	ν(CC)	3060 (ns)	ν(CH) ring
		3284 (L)	ν(NH), crystalline
		3325 (G)	ν(NH), crystalline
		3415 (G)	ν(H ₂ O)

ns : not studied; L : Lorientzian; G: Gaussian

The band near 506 cm⁻¹ is assigned to the S-S stretching mode. It has been reported that the position of this band varies with different disulfide conformers and that less stable disulfide conformers contribute to hair brittleness

