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Speaker Abstracts

Session B: Hair & Scalp Health

Harnessing AI and Biotechnology for Designing Novel Peptides for Disulfide Bond Repair in Hair

Dr. Monica Castro Cruz; Cambrium GmbH

Dr. Monica Castro Cruz (Cambrium GmbH), Dr. Lucile Bonnin (Cambrium GmbH)

Heat and chemical treatments damage hair by breaking cystine bonds, weakening both structure and appearance. Traditional solutions like keratin or amino acids offer limited repair and can cause buildup. Leveraging AI and biotech, researchers designed Proline- and Glycine-rich peptides that restore disulfide bonds while preserving hair elasticity. These bioactives were identified using a proprietary AI platform and produced via precision fermentation in yeast. Evaluated through spectroscopy, tensile testing, hydration analysis, and imaging, the lead peptide showed remarkable efficacy: +56% cystine bond restoration after four applications, +22% tensile strength after one use, and +20% hydration. Imaging confirmed deep fiber penetration with 92% saturation and 10x higher efficacy on damaged versus virgin hair. This work challenges conventional approaches and demonstrates AI's power to develop high-performance, sustainable cosmetic ingredients. The result is a new class of non-keratin actives that combine bioactivity, scalability, and cosmetic functionality.

Inside-Out Protection: Dual-Mode Biotech Silk Polypeptides for Hair Surface and Cortex Reinforcement

David N. Breslauer. PhD; Bolt

Bolt Threads

David N Breslauer, PhD, Christopher Rasmussen, PhD

Designer silk polypeptides offer a next-generation solution to the clean beauty challenge: delivering high-performance hair care without silicones, quats, or animal proteins. We developed a 70kDa β-sheet–forming silk polypeptide (SBP) that assembles into flexible nanofilms, and a 3–4kDa oligopeptide (SOP) that penetrates deep into the hair cortex. Used together, these peptides form an inside-to-outside scaffold--reinforcing internal keratin structure while sealing the cuticle with a durable, breathable film. After ten leave-in cycles, the blend increased fatigue life by 173%, raised keratin denaturation temperature and enthalpy, and doubled curl retention under heat and humidity versus a 5% silicone elastomer benchmark. Fluorescence imaging confirmed complementary deposition: SBP formed a uniform surface film, while SOP diffused throughout the cortex. The result is a lightweight, biodegradable, and vegan alternative to traditional actives that protects, reinforces, and styles without compromise. This work positions designer silk polypeptides as a platform technology capable of replacing multiple legacy technologies.

Substantiating Hair Bond Repair Claims Using Confocal Raman Spectroscopy

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Disulfide bonds are critical for hair strength and shape, yet they are vulnerable to damage from chemical and thermal treatments. This study used Confocal Raman Spectroscopy to directly evaluate disulfide bond alterations in virgin blond hair subjected to chemical (bleaching, relaxing) and thermal (blow-drying, flat ironing) treatments. Spectra were recorded along the z-axis into the hair fiber to a depth of 20 microns. Results showed a marked reduction in the S–S band intensity across all treated samples, indicating significant disulfide bond damage (content and configuration) both at the surface and within the cortex. Chemical treatments were the most damaging, though thermal styling also caused detectable bond degradation. Importantly, several rinse-off and leave-in treatments demonstrated measurable repair of disulfide bonds. This study demonstrates that Confocal Raman Spectroscopy is a powerful tool for assessing hair damage and supports efficacy claims for bond repair and protection products in the hair care industry.

Glypicans in Hair Follicle Dynamics: Role as Therapeutic Targets in Alopecia

Presenter Name; Philip Ludwig

Philip Ludwig; BASF Beauty Care Solutions

Glypicans (GPCs) are essential heparan sulfate proteoglycans (HSPGs) involved in hair growth and follicle formation. They play a significant role in embryonic development, hair follicle formation, and keratinocyte differentiation. GPCs regulate the proliferation and differentiation of dermal papilla cells, interacting with key signaling factors like Wnt, BMP, and Shh. Our study investigated GPCs' role in hair follicle formation to evaluate their therapeutic potential. Using InfraRed Spectral Imaging, Western Blot, and immunostaining, we examined GPCs 1, 4, and 6 distribution in hair follicles. GPC1 was found in the hair matrix, indicating its potential as a catagen phase biomarker, while GPC4 and GPC6 were prominent in the inner root sheath during the telogen phase. These findings suggest GPCs' roles in stem cell differentiation and their importance in hair growth and follicle formation.