SMART Resilin

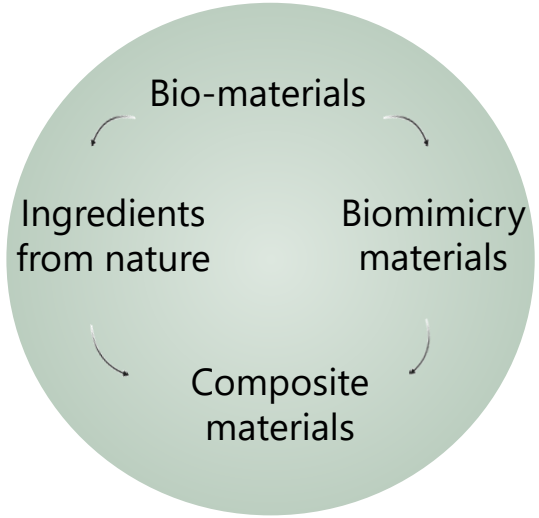
Bio-materials

The Earth's natural resources are vital to the survival and development of the human population.

However, these resources are limited by the Earth's capability to renew them.

Biomimetics is a design of materials in which inspirations are elicited from nature. Recombinant proteins are an example of such.

Until now, recombinant protein are mainly used for research purposes. Their industrial use is driven by the cost-effectiveness, ease of the process, and rapid speed that produces high-quality yields.



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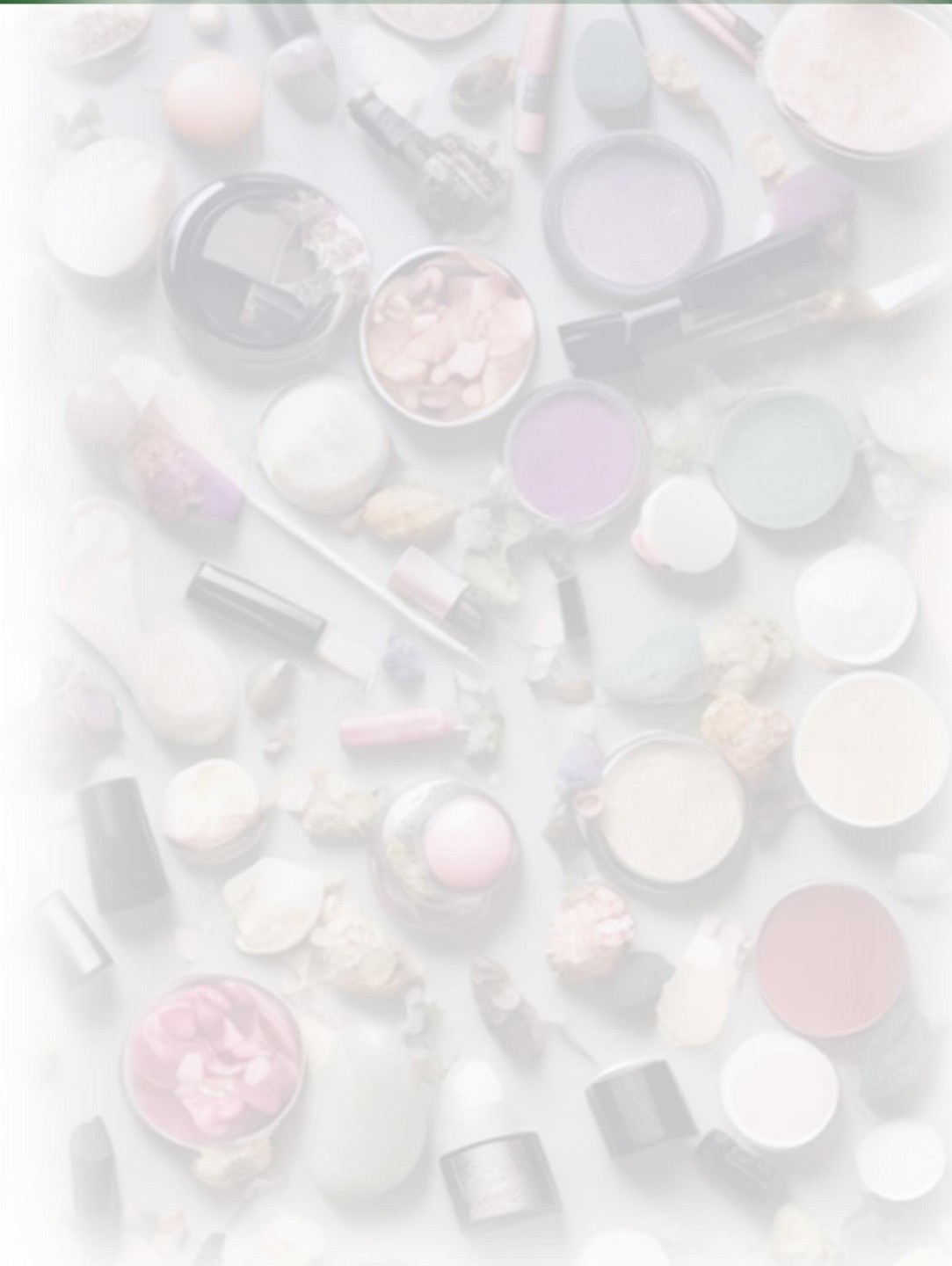
Proteins in Cosmetics

Proteins are a common ingredient in cosmetics, particularly in skin and hair care products.

They are believed to have nourishing and conditioning properties and are often used to strengthen and repair the skin and hair.

Proteins, being the fundamental building blocks of our body, possess unique properties that make them a perfect fit for green cosmetics.



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Resilin Protein

Resilin, a naturally occurring, glycine and proline rich protein has elastic properties that allow it to stretch and bounce back without breaking, making it a perfect ingredient for anti-aging and anti-wrinkle products.

It is also a natural and environmentally friendly alternative to synthetic ingredients commonly found in cosmetics.

By incorporating resilin into products, it can provide a unique and effective solution for cosmetics needs.

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Resilin Qualities

- ✓ High elasticity
- ✓ High resilience
- ✓ Fatigue resistance
- ✓ High tensile stress
- ✓ Energy storage
- ✓ Low deformation
- ✓ Biological Compatibility
- ✓ Environmental Resistance: UV, Temperature

Material	Elastic modulus (MPa)	Tensile strength (MPa)	Failure strain (%)	Resilience (%)	Toughness (MJm-3)	Sustainability
Resilin	2	4	190	92	4	V
Elastin	1.1	2	150	90	1.6	V
Collagen	1200	120	13	90	6	V
Dragline silk	10000	1000-4000	27-35	35	160	V
Silkworm fibroin	12	7000	600	18	70	V
Wheat gluten fibers	226	5000	115	23	low	V
Synthetic Rubber	12	1	50	850	100	X
Silicon elastomers	0.5-62	0.138-165	5.00 - 1490	25-65	low	X

	In Vitro		**In Vivo**	
	Cell viability and cytocompatibility	Cell attachment spreading and proliferation	Minimal to no inflammation reactions	Retained normal properties and recovery
RLP	HFFF2 [human fetal foreskin fibroblast] [3]		Injection to vocal fold, murine subdermal dorsum [1]	
RLP hydrogel	NIH 3T3 fibroblasts [5]	Human Bone Marrow Mesenchymal Stem Cells [1] Human mesenchymal stem cells (hMSCs) [4] NIH 3T3 fibroblasts [5]	Injection to vocal fold, rabbit [1] Subdermal Injection, wild-type BALB/C male mice [2] Subcutaneous transplantation, rat model [4]	Injection to vocal fold, rabbit [1] Subdermal Injection, wild-type BALB/C male mice [2] Subcutaneous transplantation, rat model [4]

Resilin and Cosmetics

Resilin protein is believed, in addition to its known elastic properties, to improve the hydrating or softening effect of skin and hair.

Resilin in cosmetic aspect

- Hydrating properties
- Coating layer
- UV-blocking agent
- Specific binding domains for strong interactions
- Electrostatic and weak interaction
- Biocompatibility and cells proliferation

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Smart Resilin- Our Secret Sauce

Biomimicry

Harnessing nature power- Resilin can be tailored fit with other materials and various binding domains

Cutting Edge Technology

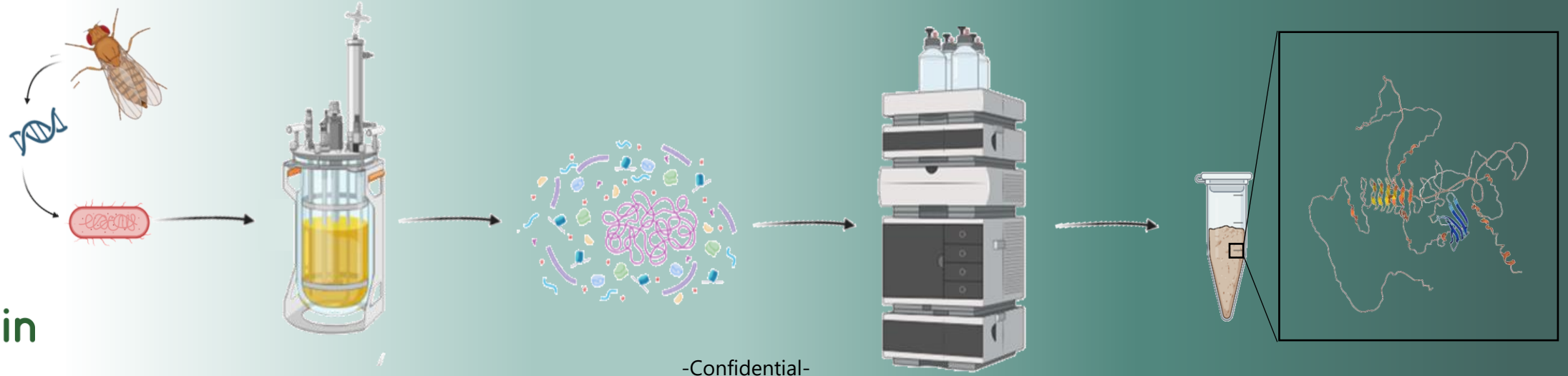
Using genetic engineering techniques, we clone the DNA into bacterial cells to produce the resilin for us

Breakthrough

Forefront of innovation as first to develop industrial scale production of eco-friendly, sustainable with circular economy Resilin

Core IP – The Hebrew University spinoff

Protein produced in simple fermentation process



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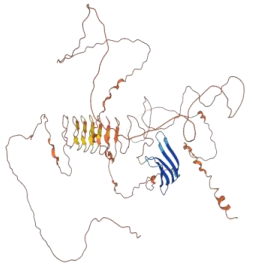
RES-CBD by Smart Resilin

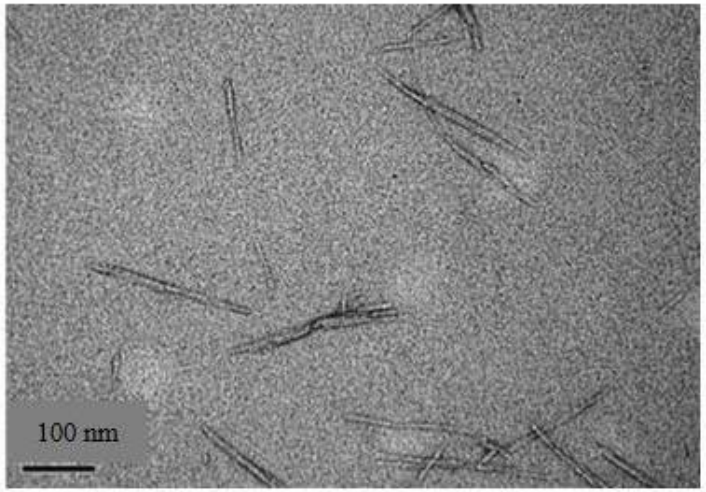
Mimicking Nature, we replaced the chitin biding domain with a cellulose binding domain, generating RES-CBD.

CNC

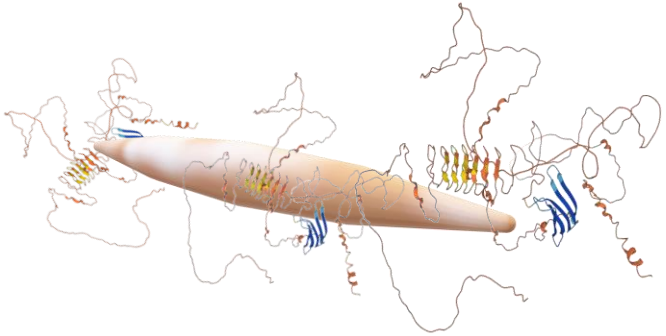


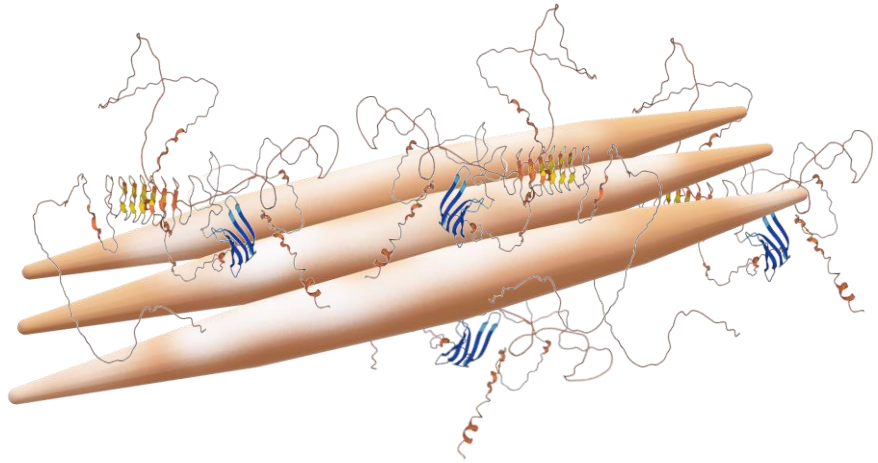
RES-CBD

RES-CBD enables to generate novel nanocomposite materials with outstanding mechanical properties.



TEM image of individual CNCs. Verker R. et al, 2014





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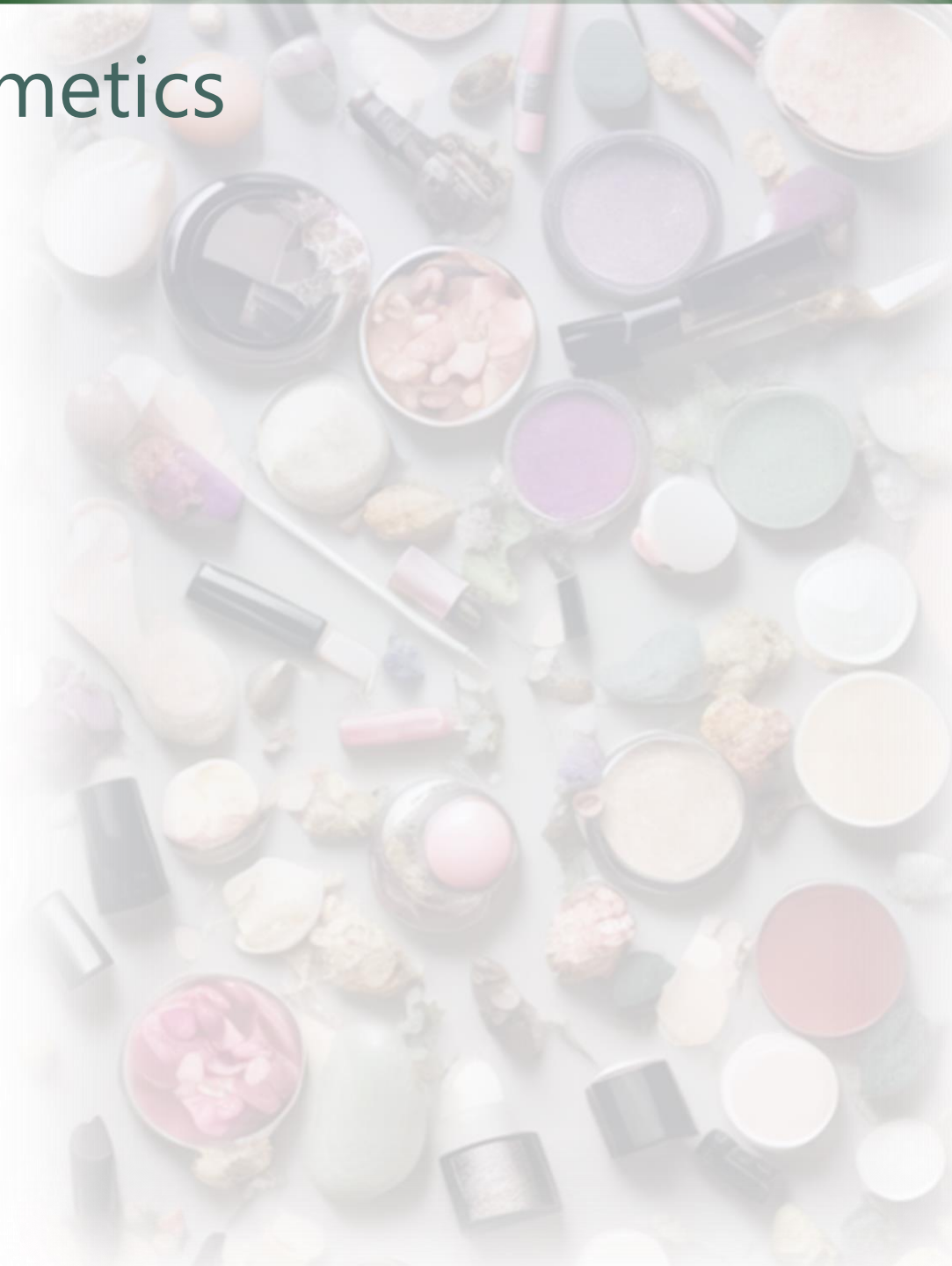
RES-CBD by Smart Resilin in Cosmetics

- Our scientists developed Resilin formulations and composites for cosmetics
- Resilin was found to be a UVB absorber
- Resilin act as a cell growth promoter
- Resilin is suggested as a softening and hydration agent
- Resilin is suggested as anti frizz compound (hair)
- Resilin was found as hair and skin restorer
- Resilin is compatible with other biopolymers for the fabrication of films and hydrogels
- Resilin formulation was tested for skin and hair care



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Resilin POCs in Cosmetics

Film Formation

Anti-wrinkle effect

Novel hair reinforcement and smoothening approach based on Smart Resilin' IP

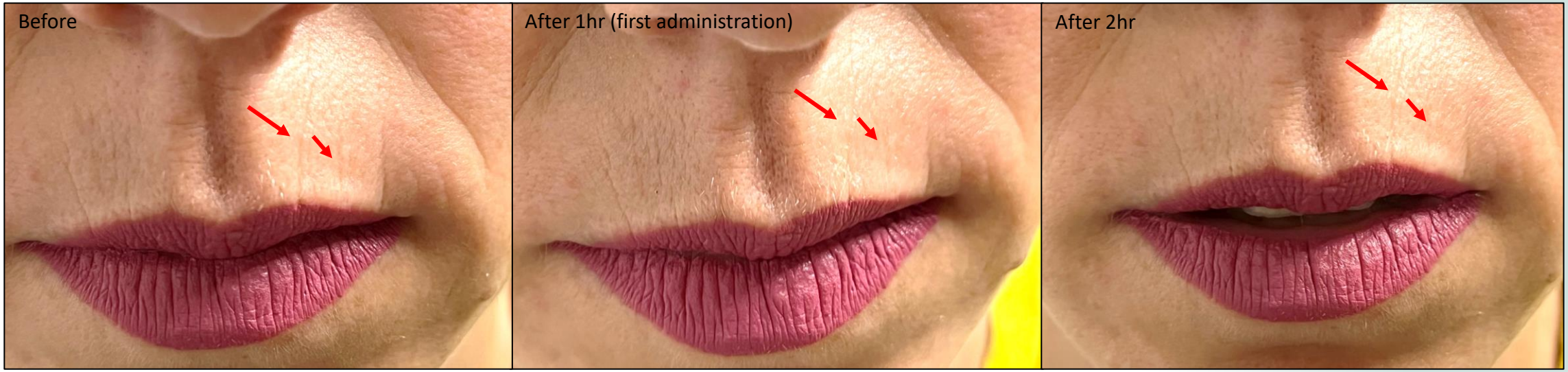
Resilin "Reviving" Treatment

SMART Resilin

Anti-wrinkle Effect

SMART Resilin

Anti-wrinkle Immediate Effect



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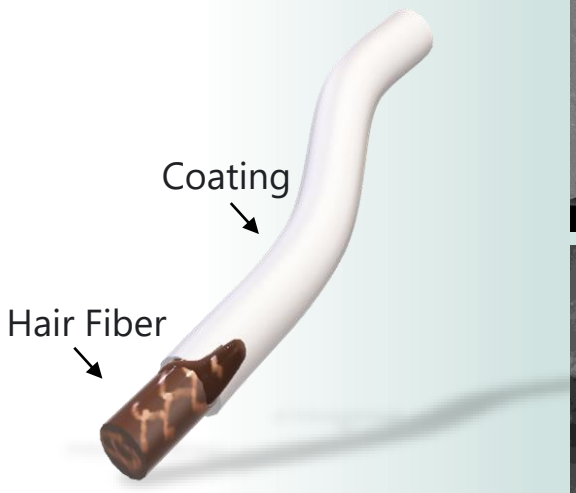
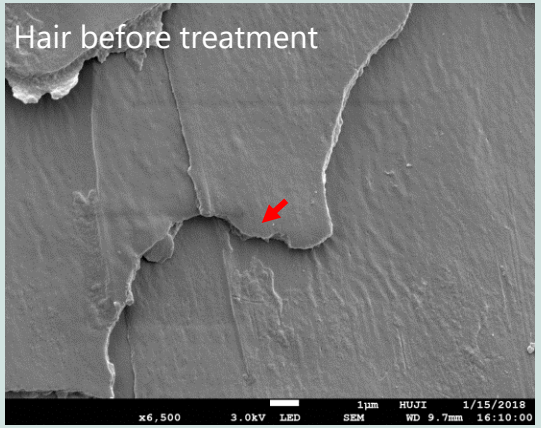
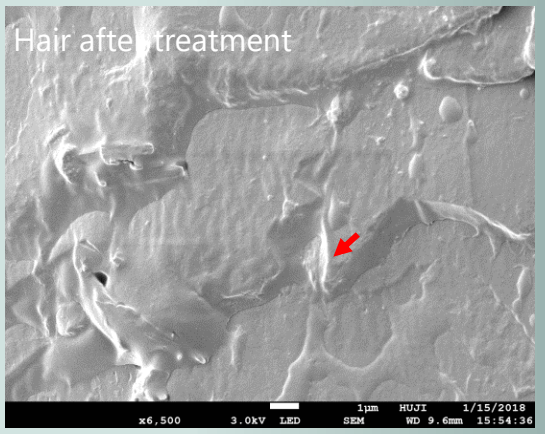
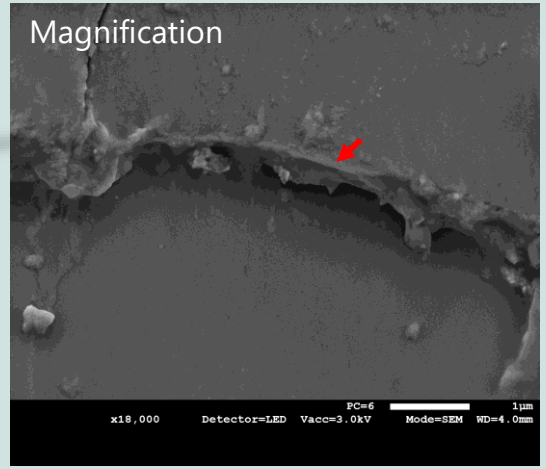
Smart Resilin Hair Botox

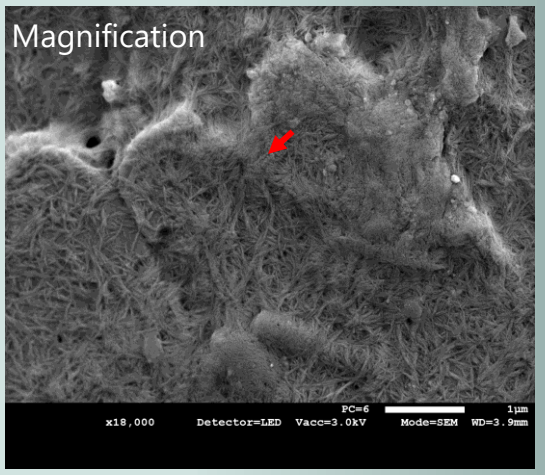
- Using only natural, healthy materials, hair structure does not change its nature











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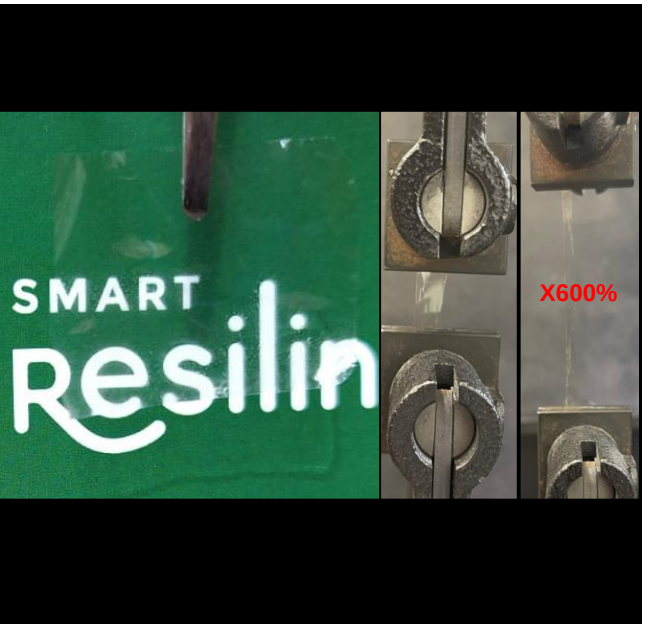
Resilin Fabrication

RES-CBD Films

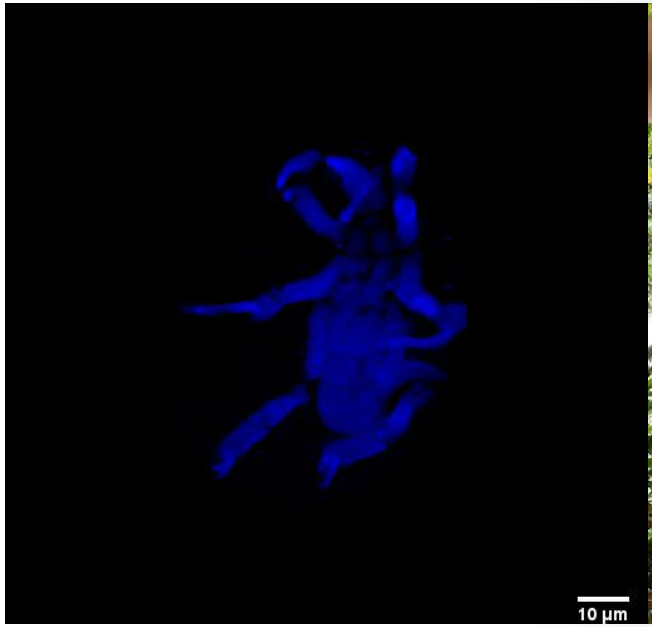


RES-CBD Hydrogels

Recombinant exon-encoded resilins for elastomeric biomaterials

Guokui Qin [a,1], Amit Rivkin [b,1], Shaul Lapidot [b], Xio Hu [a], Itan Preis [b], Shira B. Arinus [b], Or Dgany [c], Oded Shoseyov [b,**], David L. Kaplan [a,*]

RES-CBD 3D ink



3D Printing of Resilin in Water by Multiphoton Absorption Polymerization

Doron Kam, Aaron Olender, Amir Rudich, Yoav Kan-Tor, Amnon Buxboim, Oded Shoseyov, and Shlomo Magdassi

RES-CBD Composites

Bionanocomposite Films from Resilin-CBD Bound to Cellulose Nanocrystals

Amit Rivkin,[1] Tiffany Abitbol,[1,2] Yuval Nevo,[1] Ronen Verker,[3] Shaul Lapidat,[1] Anton Komarov,[4] Stephen C. Veldhuis,[3] Galit Zilberman,[5] Meital Reches,[6] Emily D. Cranston,[2] and Oded Shoseyov[1]

Insertion of nano-crystalline cellulose into epoxy resin via resilin to construct a novel elastic adhesive

R. Verker, A. Rivkin, G. Zilberman

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