A Minimalist Peptide Elastomer

Results in Brief

Elastic facial fillers inspired by jumping insects may be coming soon

Incredible elasticity enables fleas to jump and mosquitoes to beat their wings 600 times per second. An elastic polymer (elastomer) produced using only a small fragment of the natural protein, resilin, will make this elasticity available for numerous applications at competitive prices.

FUNDAMENTAL RESEARCH

HEALTH

© Michal Ninger, Shutterstock

Resilin is a natural rubber-like protein with outstanding elasticity critical to the flight and jumping systems of insects. It is normally disordered; in response to stress, it becomes organised – and elastic. Recently, scientists discovered that they can replicate this behaviour using just a small part of the original peptide. The EU-funded MINIRES project enabled them to pave the way to large-scale production of innovative bioelastomers for the plastics, biomedical, and personal care sectors at a fraction of the current cost.

Reducing the rubbery bounciness of insects to several amino acids

Halogens include fluorine, chlorine, bromine and iodine. Replacing a hydrogen with a halogen (halogenation) is a very important reaction in organic chemistry. Over the last decade, its role in the production of biogels has gained increasing attention.

Project coordinator Pierangelo Metrangolo of the Politecnico di Milano explains: “We focused on a well-conserved repeating unit of seven amino acids in resilin. By strategically halogenating this unit with two bromines, we demonstrated the emergence of a viscoelastic behaviour that resembles that of the full protein and that is not observed in the naturally occurring peptide.” This halogenation led to a more organised arrangement of the peptide, which then allowed it to form fibrils that resulted in a dense hydrogel. The gel, made of the heptapeptide, exhibited viscoelastic and self-healing properties resembling those of the full resilin protein.

Reducing the cost and complexity of production

Metrangolo continues: “Commercially available elastomers are currently large, complex polymers whose elasticity depends on covalent bonding between subunits, usually introduced by chemical or light-induced chemical reactions. In our very short peptide, we rely on physical cross-links created exploiting halogen atoms as ‘sticky’ sites. This simple molecular structure is easy and inexpensive to produce.” Scientists scaled-up the synthesis of the peptide from the lab scale to the 10-gram scale at a cost predicted to be 100-fold lower than that of the full protein production.

A world of opportunity

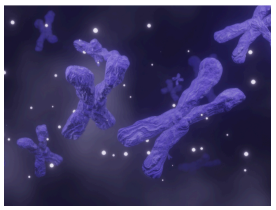
MINIRES resulted in a patent for the technology. The team has identified three important market opportunities: facial injection fillers and haircare products, thermoplastic elastomers, and biomedicine. The organic personal care and cosmetic products segment is expected to reach USD 19.8 billion by 2022, of which skincare products represent more than 30 % followed by haircare. The serendipitous discovery that the brominated peptide prevents UVA damage enhances attractiveness for skincare. The superior properties and low cost of MINIRES gels could place the group as a global leader in the huge thermoplastic polymer market. Finally, MINIRES peptides could find use in medical devices and bioscaffolds.

MINIRES may have finished but innovation and discovery are flourishing. “During the course of the project, we also discovered that our brominated peptide can be successfully combined with other biomacromolecules. New hybrid materials with improved performance and tailored properties will be a focus of future research,” says Metrangolo. The team recently won the 2017 Switch2Product innovation challenge that provides support to bring innovative ideas to market, and now Metrangolo is revving up to deliver novel bio-inspired macromolecules with finely tuned properties for targeted applications.

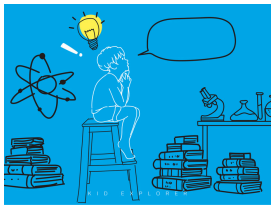
Keywords

MINIRES, peptide, protein, elastic, elasticity, polymer, resilin, amino acid, bromine, halogen, organic, elastomer, thermoplastic, cosmetic, self-assembly, biogel, bromination

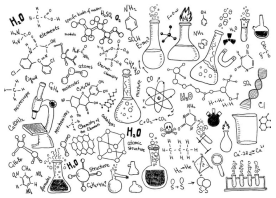
Discover other articles in the same domain of application



Shedding more light on how the body controls our immune systems



Two EU-funded researchers receive 2025 Wolf Prize



An age-old physical chemistry conundrum is finally solved

Mapping gene expression in two colours

Project Information

MINIRES

Grant agreement ID: 789815

DOI
10.3030/789815

Project closed

EC signature date
9 March 2018

Start date
1 April 2018

End date
30 September 2019

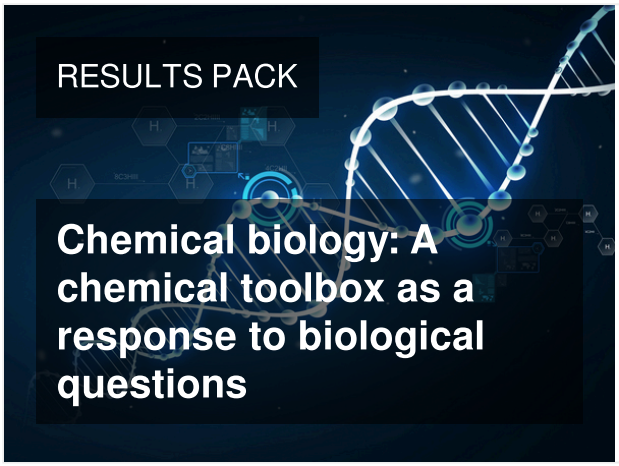
Funded under
EXCELLENT SCIENCE - European Research Council (ERC)

Total cost
€ 150 000,00

EU contribution
€ 150 000,00

Coordinated by
POLITECNICO DI MILANO
Italy

This project is featured in...



30 June 2020

Related articles

SCIENTIFIC ADVANCES

Tiny silica particles: Powerful agents that could wipe out bone diseases

30 June 2020

Last update: 26 June 2020

Permalink: https://cordis.europa.eu/article/id/418491-elastic-facial-fillers-inspired-by-jumping-insects-may-be-coming-soon