Technology Offer

Bioinspired Liquid-Superrepellent Fibrillar Dry Adhesives

Ref.-No.: 0104-5929-GÖ

Since 2000 bioinspired fibrillar dry adhesives have been studied intensively culminating in commercial products already available on the market. Currently known fibrillar adhesives are fully wetted by oils, leading to significantly decreased adhesion and friction performance. Therefore, a high demand exists for reversible dry fibrillar adhesives that can repel oil-like liquids and adhere strongly to surfaces wetted by them.

To meet the aforementioned challenges, an extraordinary fibrillar dry adhesive made of elastomeric soft materials, such as PDMS, and combining strong reversible dry adhesion with superrepellency towards all liquids, has been developed in the group of Prof. Metin Sitti at MPI Stuttgart. The developed fibrillar adhesive is a breakthrough in the bioinspired adhesives field.

Background

Since 2000 bioinspired fibrillar dry adhesives have been studied intensively culminating in commercial products already available on the market.

While the basic principles of fibrillar, reversible dry adhesives have been understood well, there are still engineering barriers and challenges to overcome; especially low cost and high volume production, and suitability for a wider range of real-world applications including manufacturing industry, robotics, sports, portable and wearable electronics, and medical devices, where low surface tension liquids such as oils are present on surfaces. Currently known fibrillar adhesives are fully wetted by oils, leading to significantly decreased adhesion and friction performance.

Therefore, a high demand exists for reversible dry fibrillar adhesives that can repel oil-like liquids and adhere strongly to surfaces wetted by them.

Technology

To meet the aforementioned challenges, an extraordinary fibrillar dry adhesive made of elastomeric soft materials, such as PDMS, and combining strong reversible dry adhesion with superrepellency towards all liquids, has been developed in the group of Prof. Metin Sitti at MPI Stuttgart. The developed fibrillar adhesive is a breakthrough in the bioinspired adhesives field.

This unique adhesive surface allows pushing away liquids, including oils, at the contact interface so that short-range van der Waals forces dominate, resulting in strong adhesion similar to dry conditions. Owing to the extreme liquid repellency, our new fibrillar adhesives also prevent liquids from collapsing between the fibrils, which is typically a catastrophic, irreversible failure mode for fibrillar dry adhesives.
To achieve these exceptional properties, arrays of microscale fibrils with re-entrant, mushroom-like tip geometries are produced with high accuracy using two-photon lithography (laser 3D printing), and subsequently replicated in PDMS using micromolding techniques. The fibril dimensions and center-to-center distance are chosen in a way that favors robust liquid repellency while maintaining strong adhesion.

Advantages
- Unique elastomeric dry adhesive based on double re-entrant fibril tip geometry combining strong reversible dry adhesion and superrepellency towards all liquids regardless of surface tension
- First fully soft liquid-superrepellent surface that is not mechanically brittle, durable against physical contact, and highly deformable, flexible, scratch-resistant and stretchable
- Use: applications where wet conditions have so far rendered conventional fibrillar dry adhesives infeasible, including medical devices, wearable electronics and robotic handling of wet objects.

Patent Information
Patent application number Nr. 19 218 616.1, filed on December 20th, 2019.
Contact

Gökçe Özyurt
Patent- & License Manager
Elektroingenieur (M.Sc. Wirtschaft)
Telefon: 089 / 29 09 19-18
E-Mail: oezyurt@max-planck-innovation.de