Bioinspired Adhesive Patch Technologies

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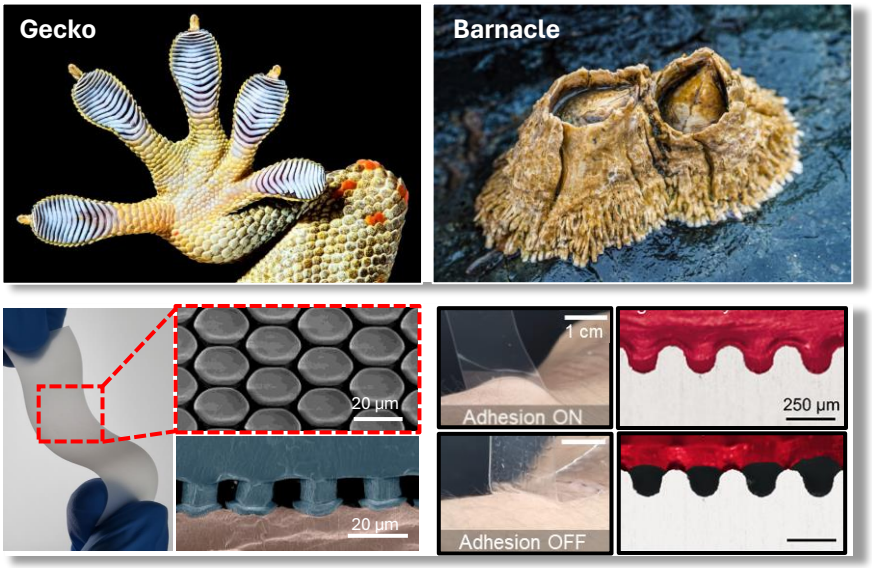
“Gecko”-inspired Dry Adhesives / “Barnacle”-inspired SMP Adhesives

- High adhesion strength with controlled, damage-free detachment
- Precisely tunable adhesion (adhesion strength/directional/switchable/on-demand on/off)
- Reusable, residue-free, reversible attachment
- Skin-friendly, bio-compatible materials
- Multifunctional integration (conductive, strain-sensing, thermal stability, etc.)

Bioinspired Adhesives

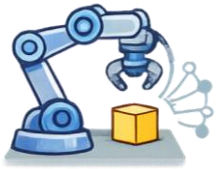
Gecko-inspired Dry Adhesives | **Barnacle-inspired On/Off Adhesives**



Applications

Semiconductor& Display Processing

Manipulators & Robotics



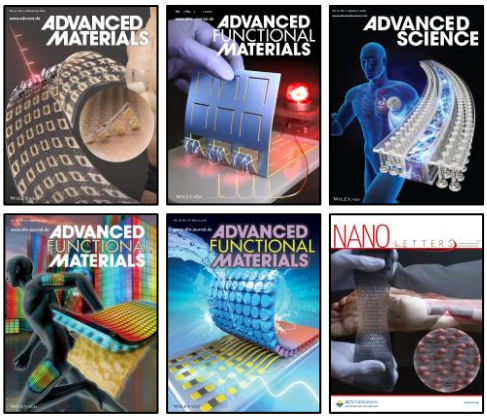
Wearable Electronics

Wearable Healthcare

World 1st, Gecko Skin Patch

Hierarchical Gecko Patch

Validated through 50+ peer-reviewed publications



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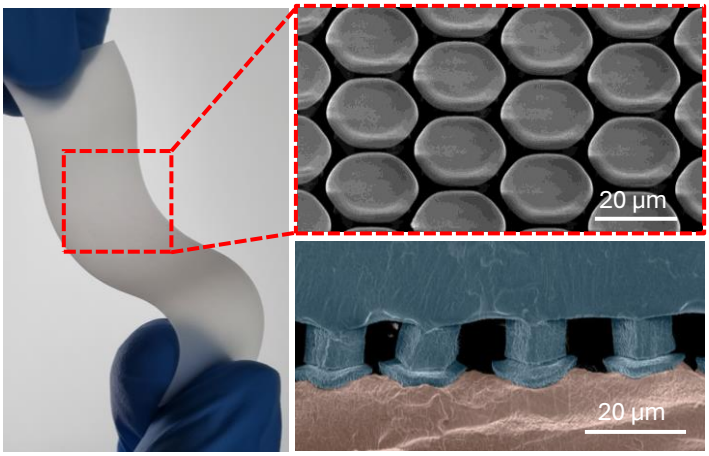
Gecko-Inspired Dry & Meta Adhesives

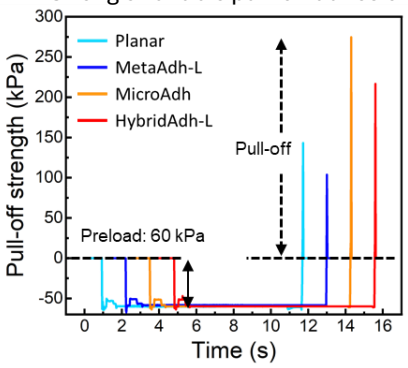
A scalable, programmable, and reusable gecko-inspired adhesive patch with tunable adhesion strength

- High adhesion strength with controlled, damage-free detachment
- Precisely tunable adhesion (adhesion strength/directional/switchable/on-demand on/off)
- Reusable, residue-free, reversible attachment
- Skin-friendly, bio-compatible materials
- Multifunctional integration (conductive, strain-sensing, thermal stability, etc.)

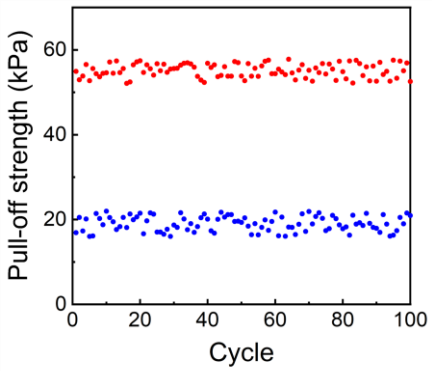


- Thickness range: 10 μm - 1 cm
- Area & size: up to 15x15 cm^2
- Normal adhesion: 1–50 N cm^{-2}
- Peel adhesion: 10-500 N m^{-1}
- Adhesion directionality & programmability: F_{max}/F_{min}>10
- Repeatability: >10,000 cycles
- Reusable & washable adhesive patch

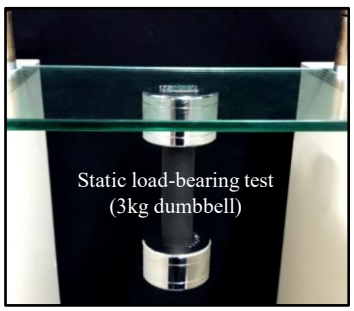
Strong & tunable pull-off adhesion



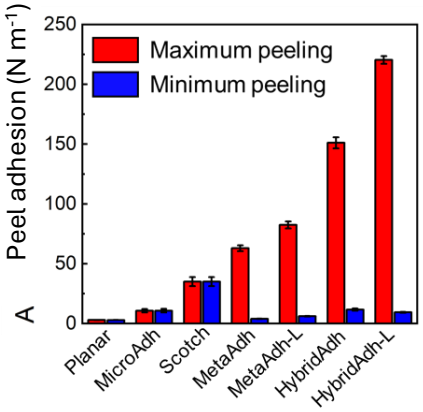
High repeatability & reusability

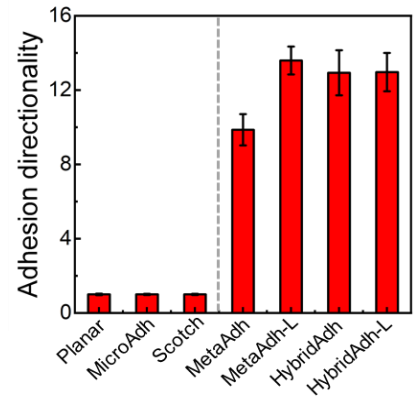


Strong & tunable pull-off adhesion

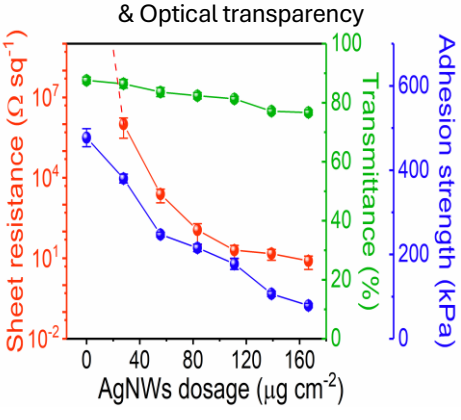


Directional adhesion: strong attachment, yet easy release





Tunable electrical conductivity & Optical transparency



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Bioinspired Dry Adhesives for Semiconductor & Display Production

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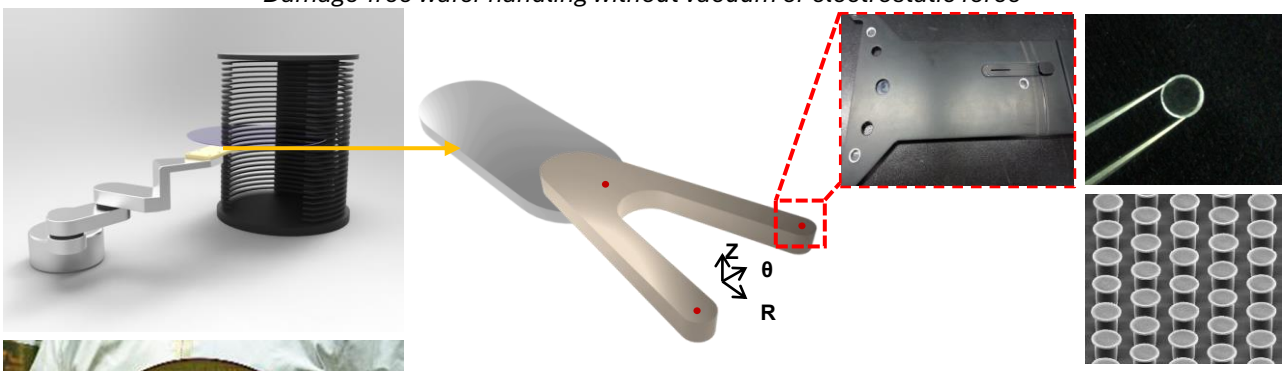
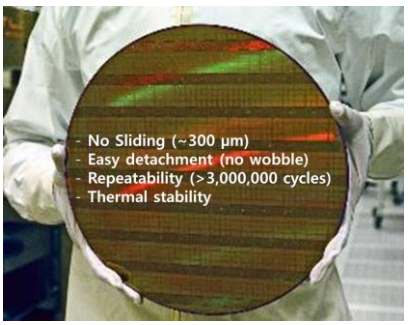
- Reusable, residue-free, and reversible adhesion for precision wafer & glass handling
- Controlled, repeatable substrate holding for “contamination & damage”-free substrate handling
- High repeatability > 1,000,000 cycles
- No sliding during handling (<300μm) / Easy, wobble-free detachment
- Multifunctional integration (conductive, strain-sensing, thermal stability, etc.)

Comparison with Conventional Wafer Handling Technologies

Precise Transportation Techniques	Holding Force	Contamination & damage	Bending	Scalability	Energy consumption	Cost
Smart-adhesive	●●●	●●●●	●●●●	●●●●	●●●●	●●●●
Vacuum/Mechanical clamping	●●●●	●	●	●●	●●●	●●
Electrostatic chuck	●●●●	●●	●●	●●	●	●

Damage-free wafer handling without vacuum or electrostatic force

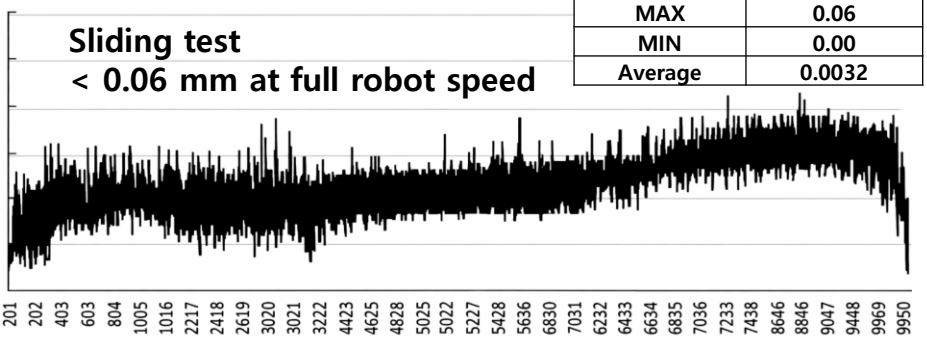




- Thickness range: 10 μm - 1 cm
- Area & size: up to 15x15 cm^2
- Tunable Adhesion strength: 1–50 N cm^{-2}
- Repeatability: >1,000,000 cycles
- Reusable & washable adhesive patch

Sliding test
< 0.06 mm at full robot speed

	Sliding (mm)
MAX	0.06
MIN	0.00
Average	0.0032



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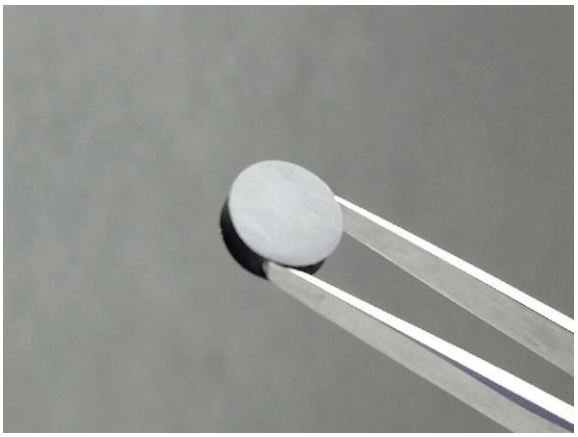
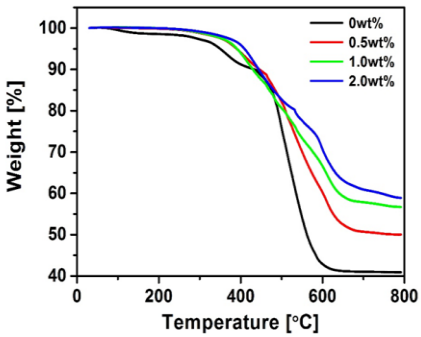
High-Temperature Dry Adhesives

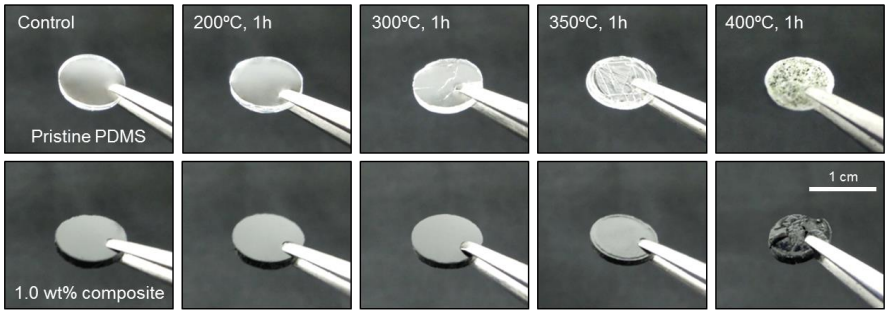
A Reusable Gecko-Inspired Adhesive Patch for High-Temperature Processes

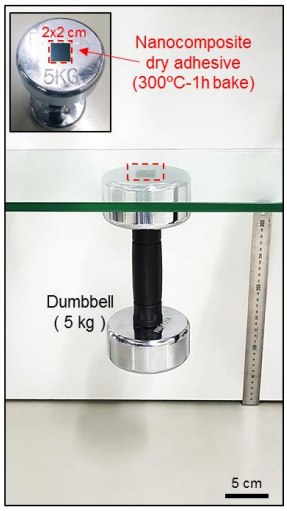
- Carbon nanomaterials-reinforced dry adhesives
- High-temperature process-compatible
- High adhesion strength with controlled, damage-free detachment
- Precisely tunable adhesion (adhesion strength/directional/switchable/on-demand on/off)
- Reusable, residue-free, reversible attachment
- Multifunctional integration (conductive, strain-sensing, thermal stability, etc.)

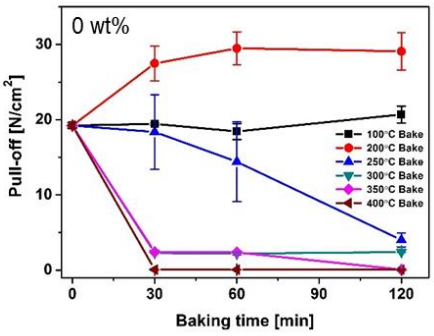


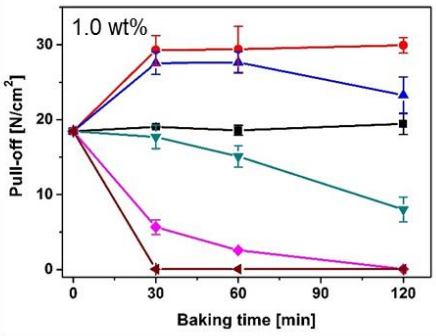
- High-Temp durability: up to 350 °C
- Thickness range: 10 μm - 1 cm
- Area & size: up to 15x15 cm^2
- Normal adhesion strength: 1–50 N cm^{-2}
- Peel adhesion strength: 10-500 N m^{-1}
- Adhesion directionality & programmability: F_{max}/F_{min}>10
- Repeatability: >10,000 cycles
- Reusable & washable adhesive patch











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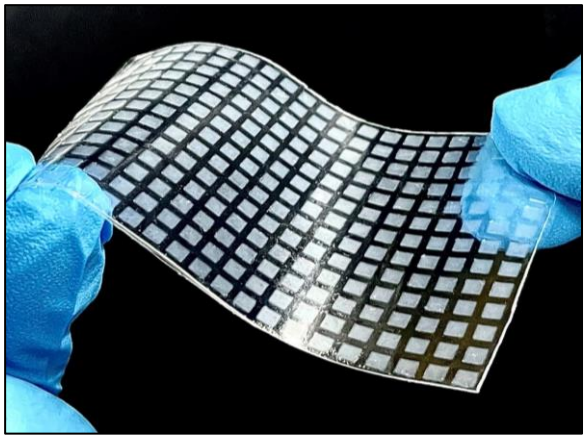
Barnacle-Inspired SMP Adhesives

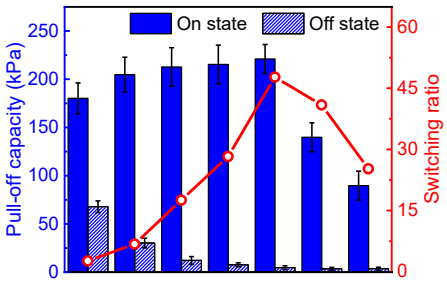
On-demand On/Off Adhesion via Electrothermal Control

- Electrothermally switchable adhesion with on-demand ON/OFF control
- Precisely tunable adhesion, including strength, directionality, and programmable switching
- Reusable, residue-free, and fully reversible attachment
- Skin-friendly and biocompatible materials suitable for long-term contact
- Multifunctional integration, enabling electrical conductivity, strain sensing, and thermal stability

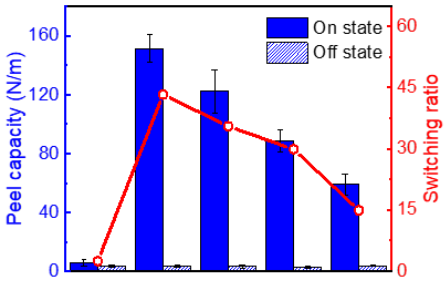


- Thickness range: 10 μm-1 cm
- Area & size: up to 15x15 cm^2
- Normal adhesion: 1–30 N cm^{-2}
- Peel adhesion: 10-200 N m^{-1}
- On/Off switching: F_{on}/F_{off}>40
- Reusable, residue-free adhesive patch

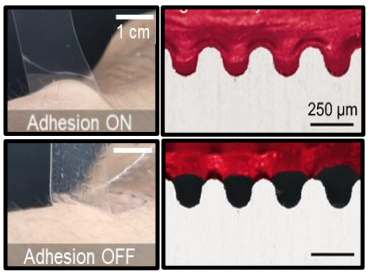
Pull-off adhesion ON/OFF property



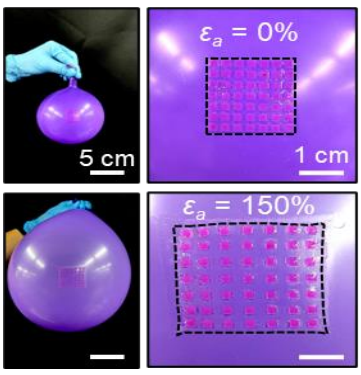
Peel adhesion ON/OFF property



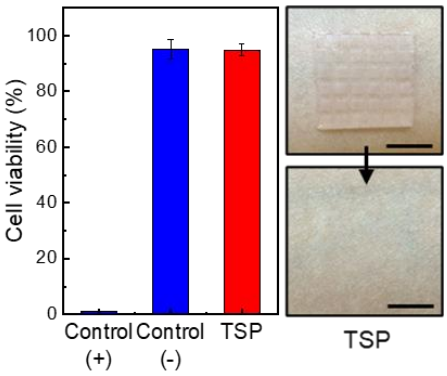
On-demand adhesion ON/OFF demo



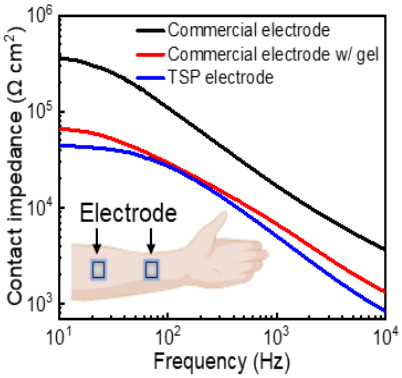
High deformability & Surface conformability



Bio & Skin- Compatibility



Tunable electrical property



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