

The ultimate O/W sunscreen by means of “fiber emulsification” Visualization of its unsurpassed performance through advanced OCT technologies

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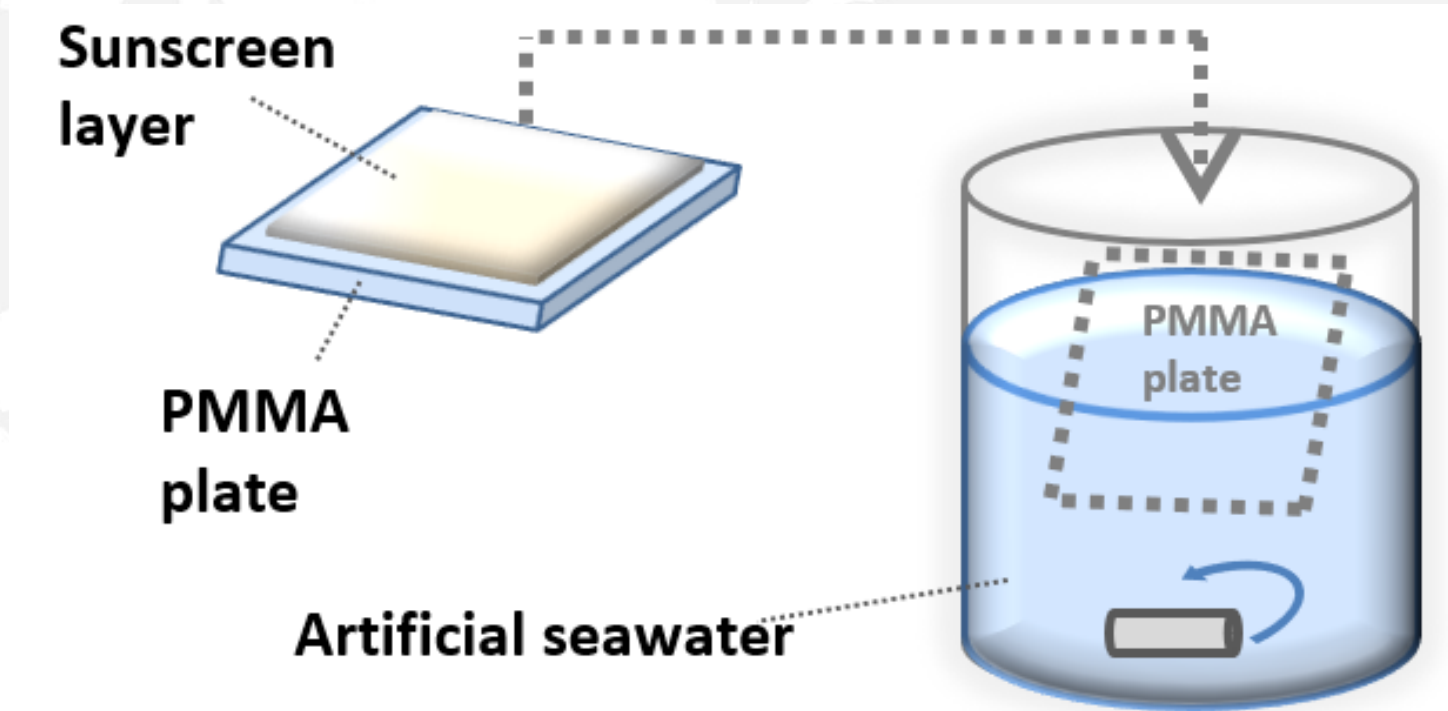
POLA R&M
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Problems with Conventional Sunscreens



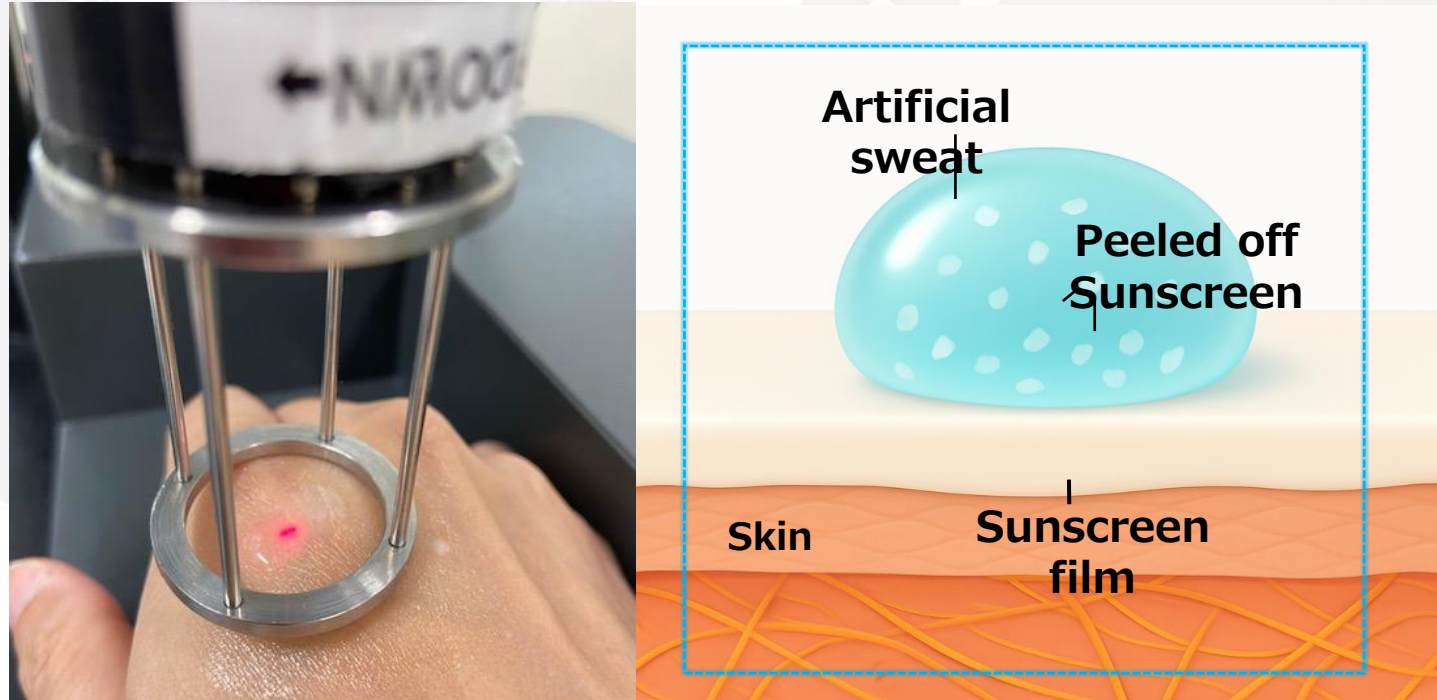
**Even though we apply sunscreen properly,
We still somehow get sunburned.**

Problems with Conventional Methods for Evaluating Sunscreen Persistence



Mainly evaluated on plates, making the mechanism unclear.

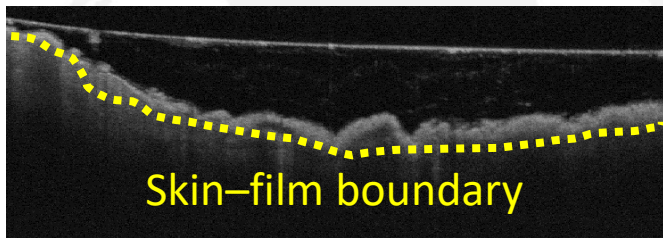
Cause Investigation and Method Development



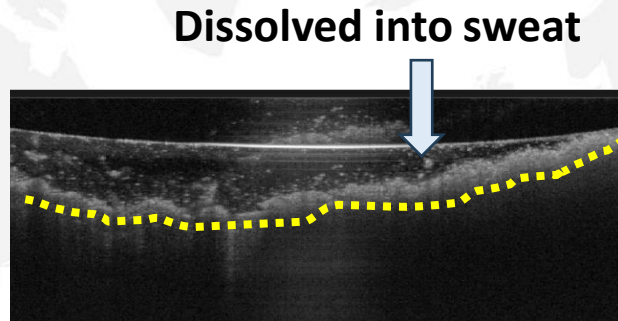
Visualization of sunscreen removal on skin using OCT(Optical Coherence Tomography).

Weaknesses of Conventional Sunscreens Identified Through Analysis

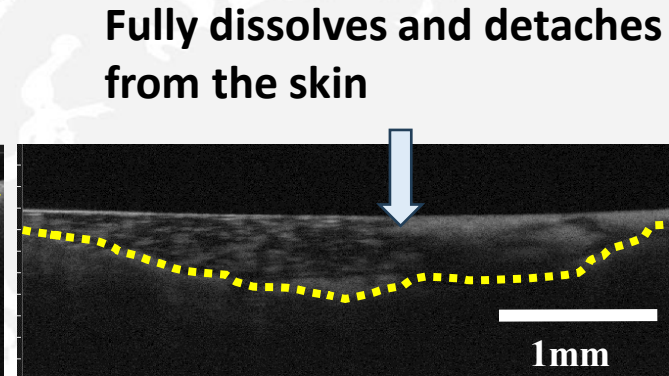
Dissolving



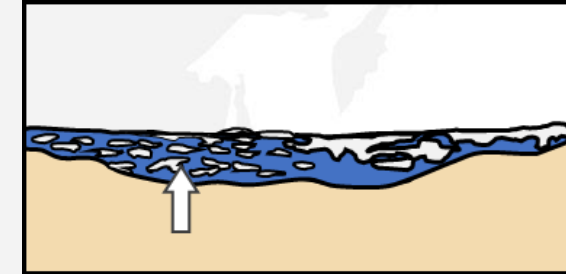
0min



3min

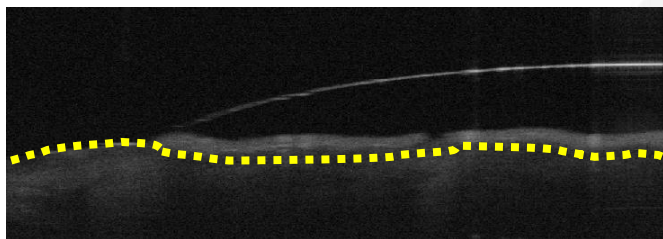


10min

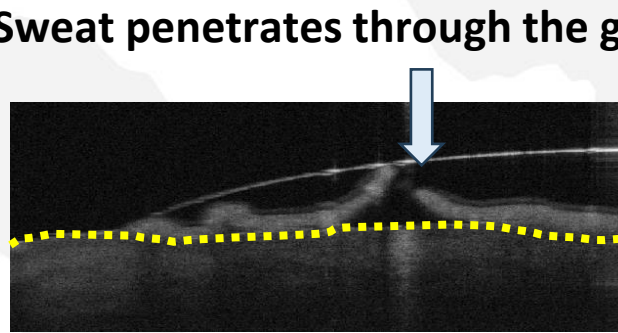


The sunscreen is dissolving into sweat.

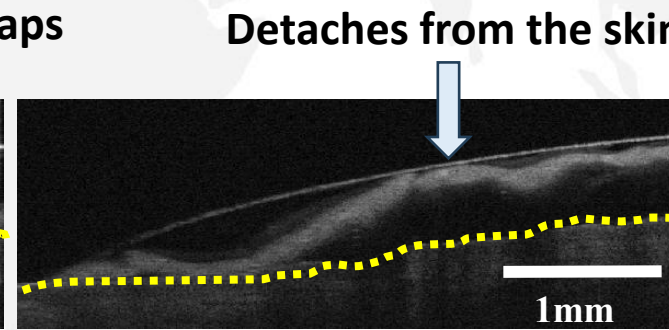
Peeling off



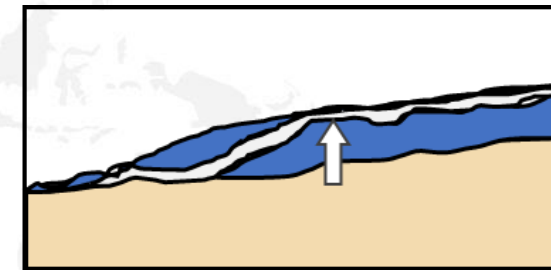
0min



3min



10min



イメージイラスト

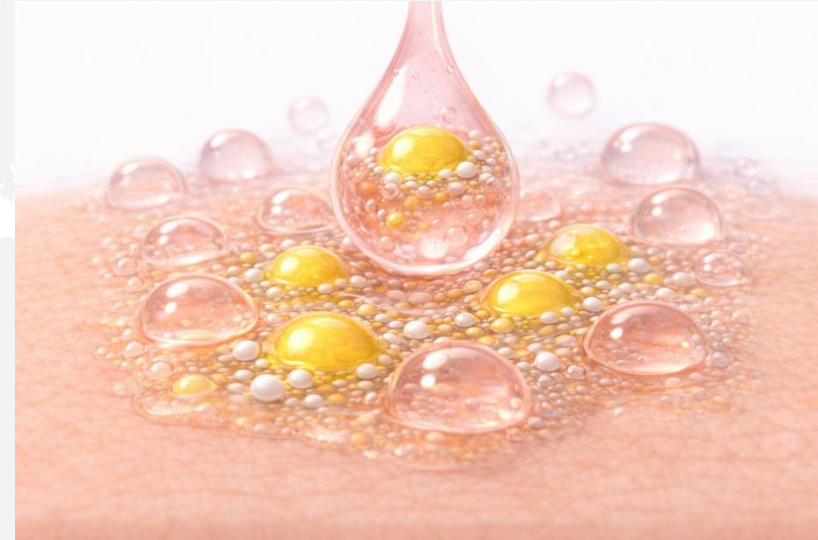
The sunscreen film peels off from the skin.

Factors Behind the Weaknesses

Surfactants that make oil mix easily with water.



Make water and oil mix well.



**If it mixes with water,
it also mixes with sweat.**

Consideration of Solutions

What if we simply remove the surfactant?

Apply oil alone.



**It is durable,
but feels heavy
and greasy.**

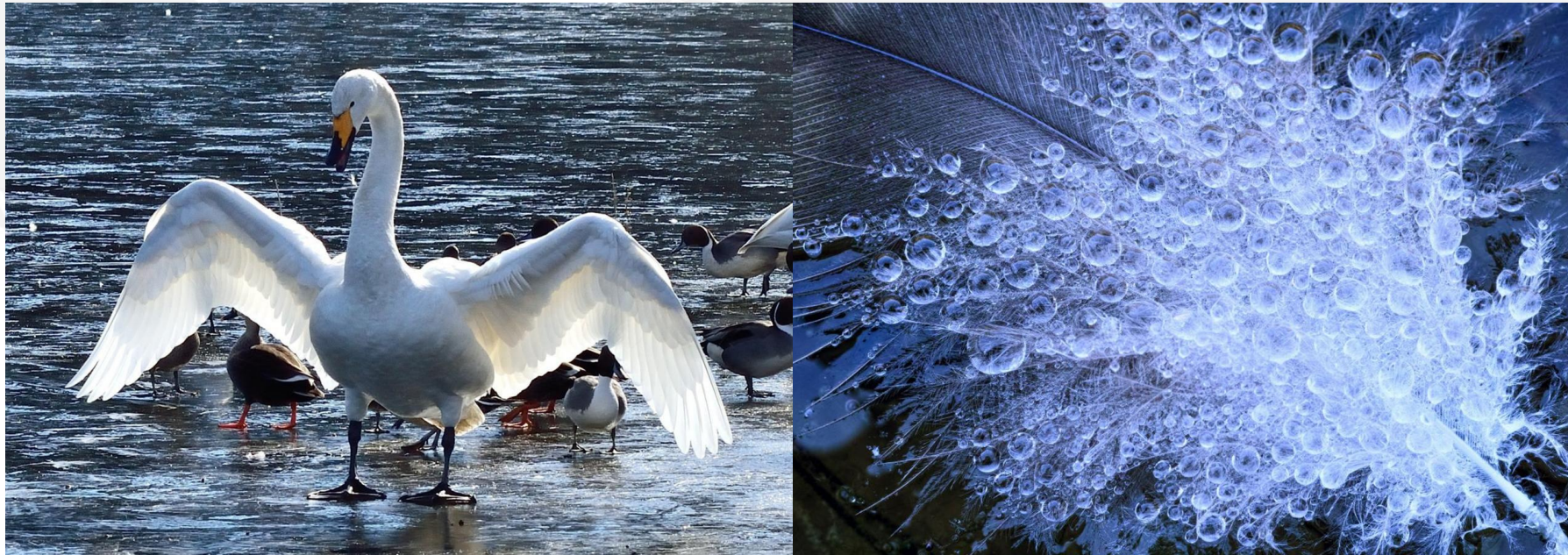
Disperses directly in water.



**Feels fresh,
but is not viable
as a cosmetic product.**

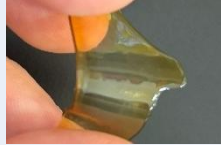
A New Approach to Solving the Problem

Inspired by waterfowl feathers,
which retain oil even in water.



Instead of “mixing” oil and water, oil is
“trapped” within fibers.

Screening and Selection of Fibers

Fiber origin	Citrus	Mushroom	Bamboo
Fiber dispersion appearance			
Dried film			
Emulsifying ability	✓	✗	✓
Film durability	✗	✓	✓

Among plant fibers, only bamboo-derived fibers retained oil and resisted water.

Selection of Sustainable Raw Materials

Abandoned bamboo forests in Kagoshima.



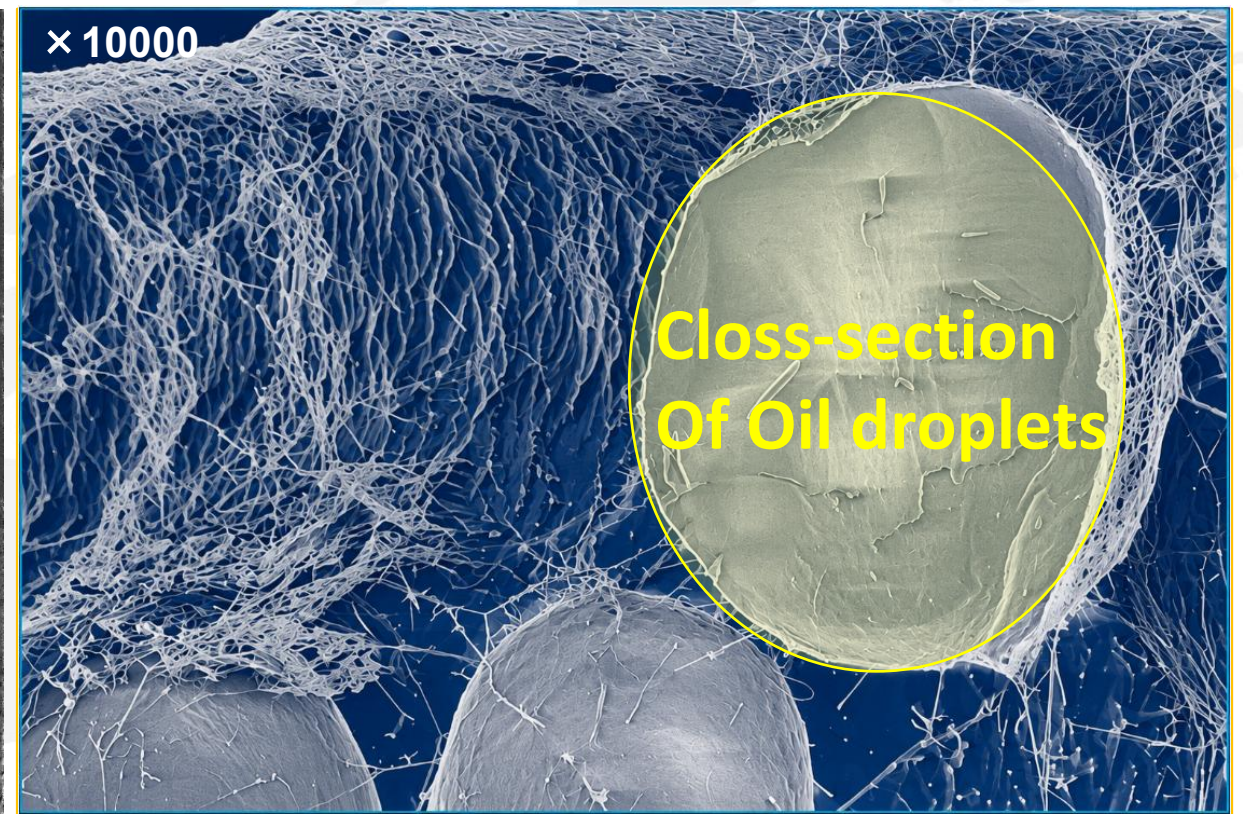
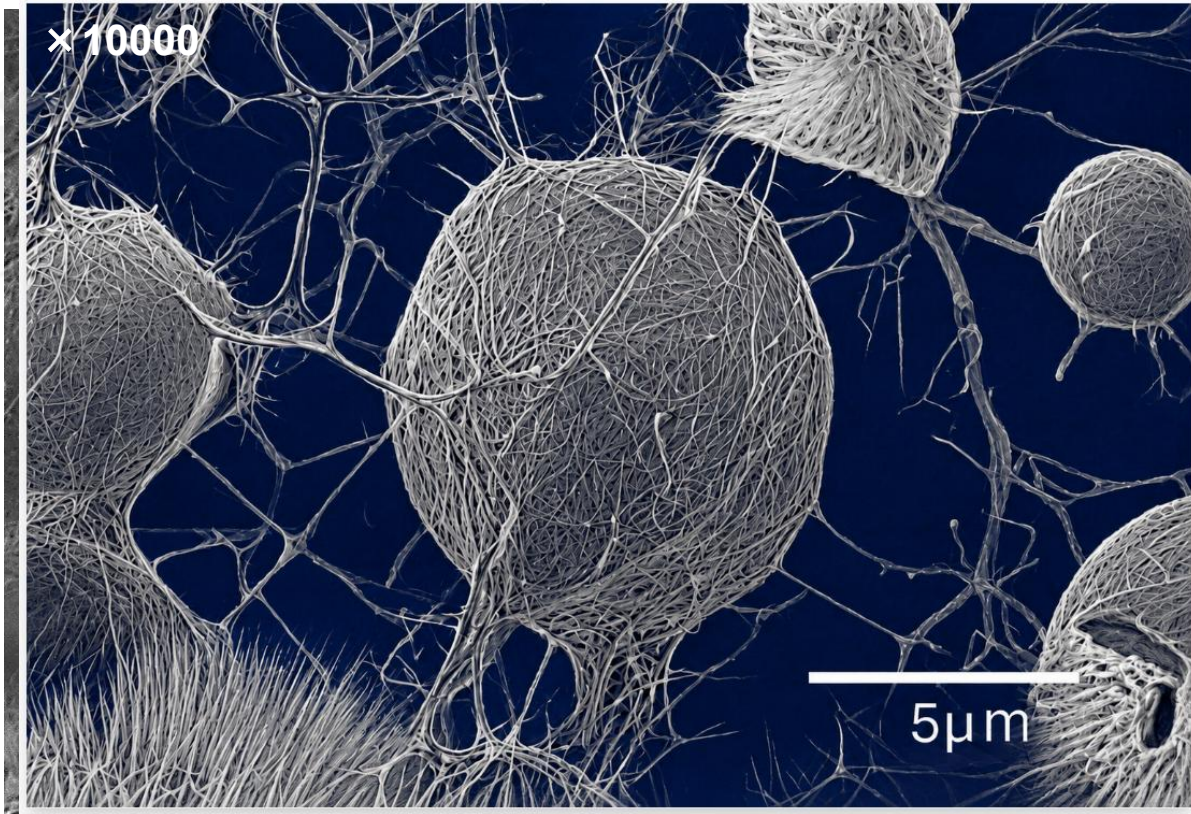
Burned for disposal.

Raw material for the fiber.



Utilized as a resource.

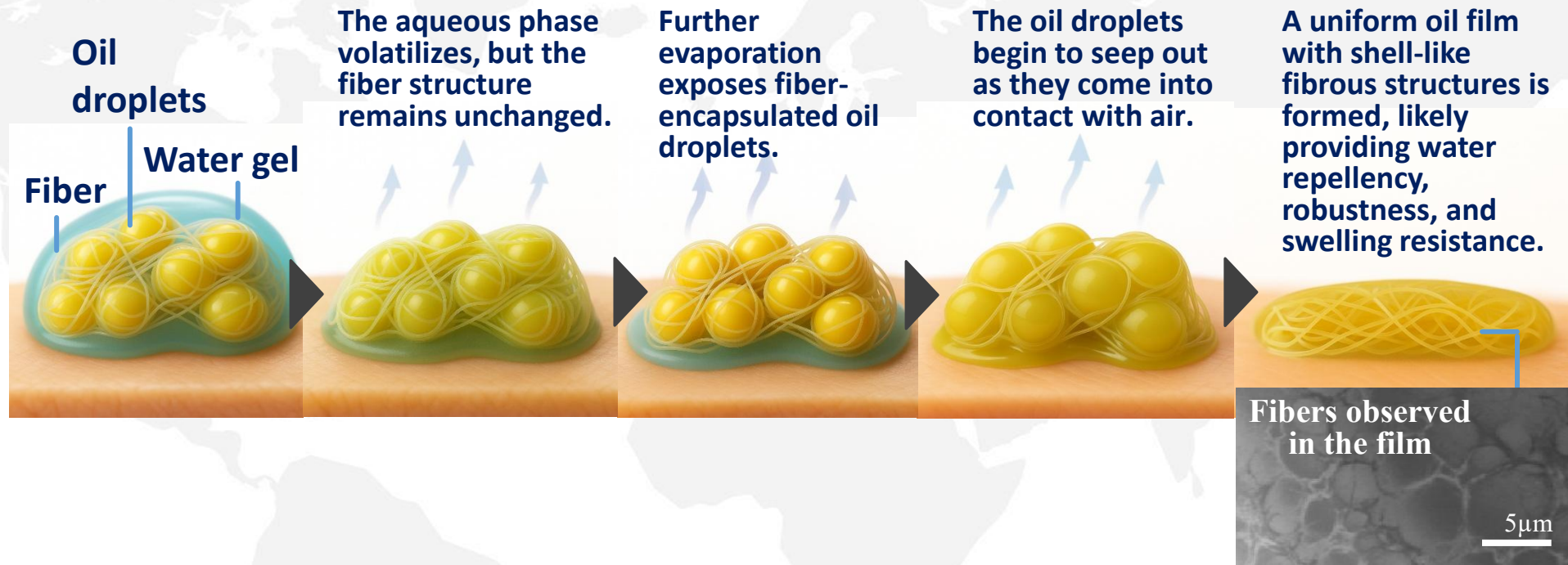
Succeeded in developing a fiber-emulsified sunscreen.



Freeze-fracture SEM images of the fiber-stabilized emulsion

Instead of “mixing” oil and water,
oil is “encapsulated” in fibers.

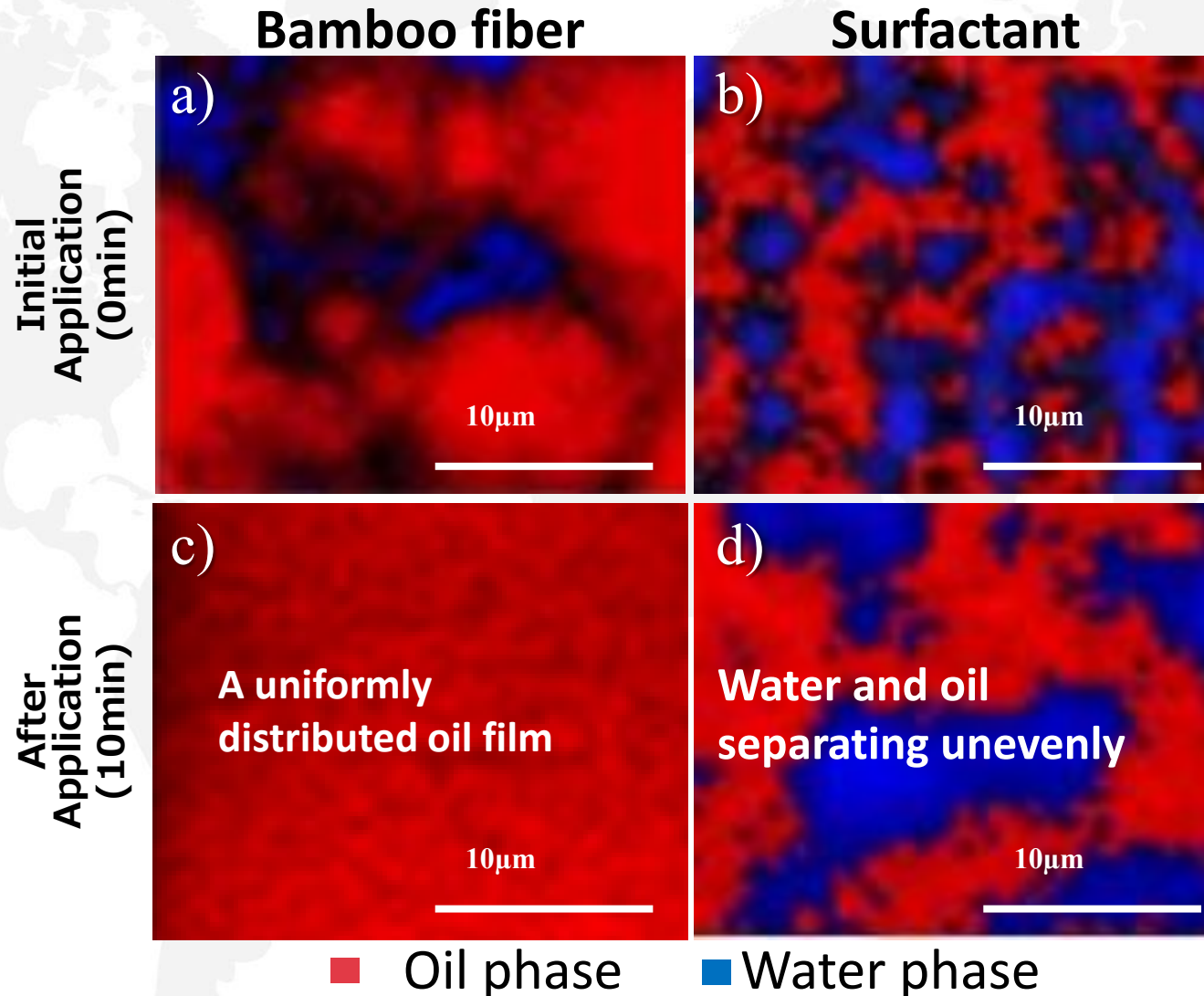
Unique Film-Formation Process of Fiber-Emulsifion



Transforms into a uniform oil film.

Proof of the Difference from Conventional Emulsions

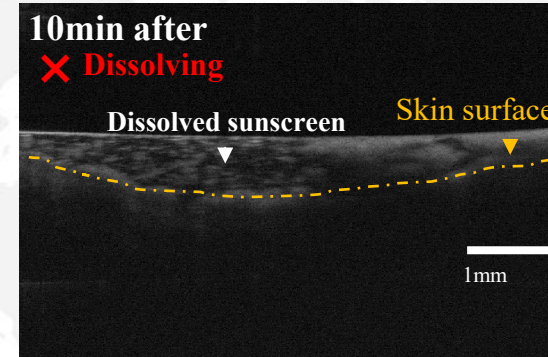
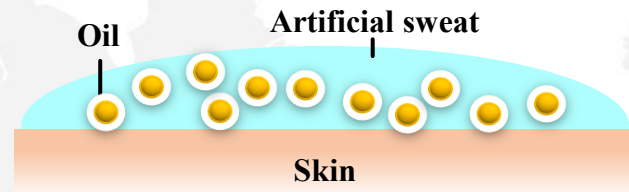
Raman mapping images showing oil and water distribution.



Durability of a fiber-emulsified sunscreen

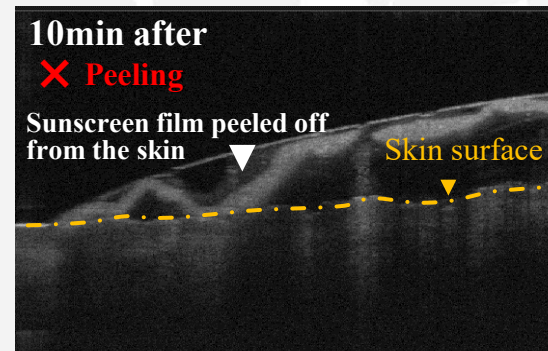
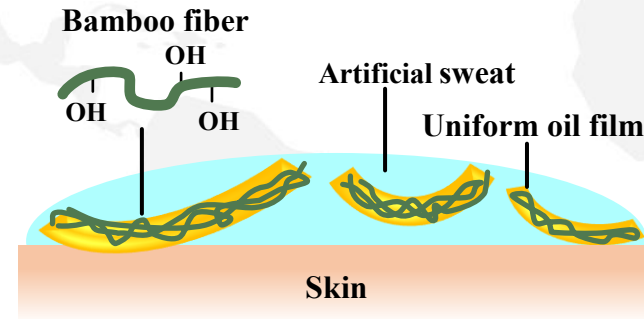
Conventional surfactant-based sunscreen

Dissolves and disperses in sweat



Fiber-emulsified sunscreen

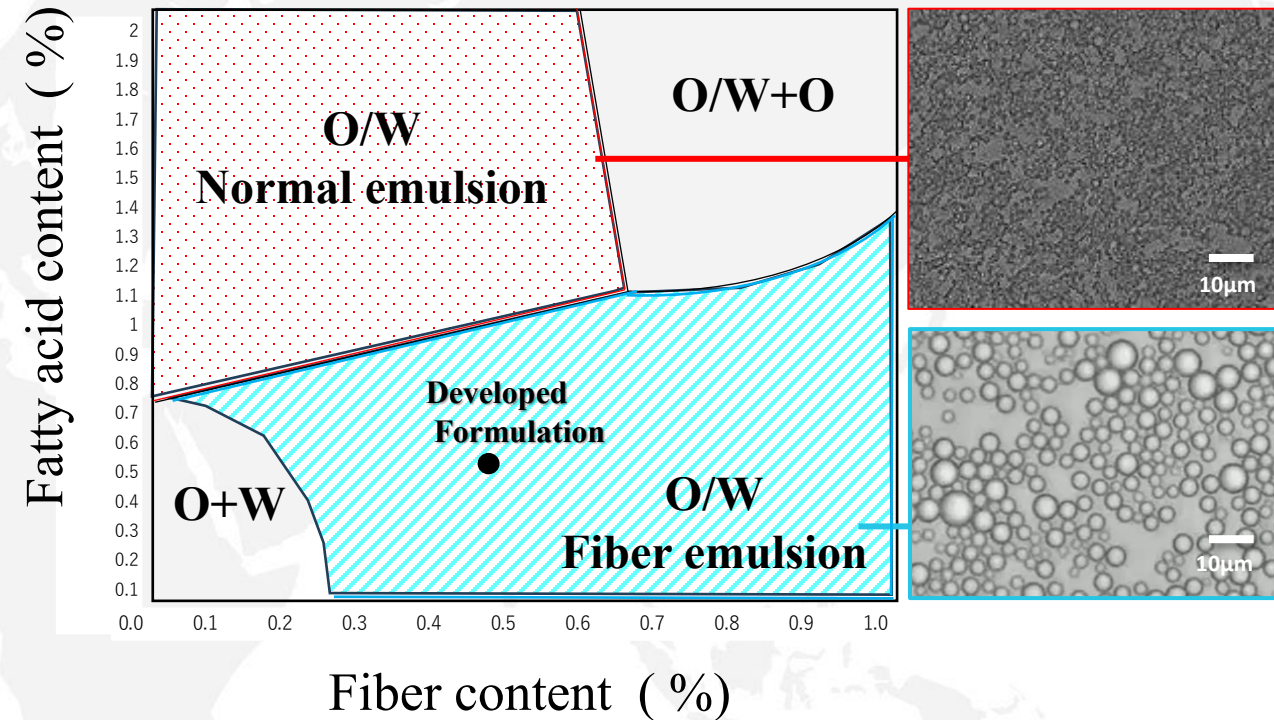
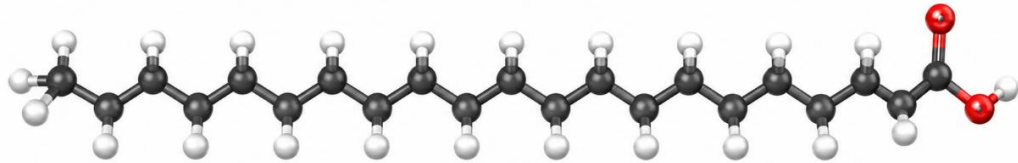
Durable film, but insufficient skin adherence



Even if a uniform oil film is formed,
insufficient adhesion will still lead to peeling.

Optimization of fatty acid content

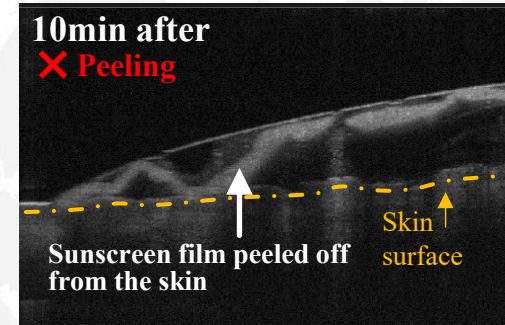
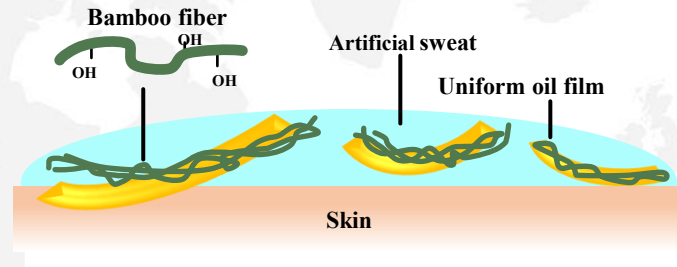
Stearic acid was used as the fatty acid in this study. C16–18 was the optimal chain length, as shorter chains reduced water resistance, while longer chains could not maintain adhesion.



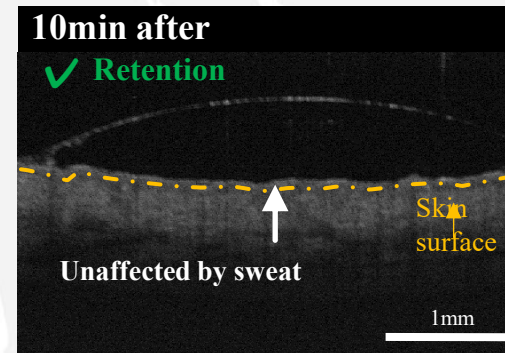
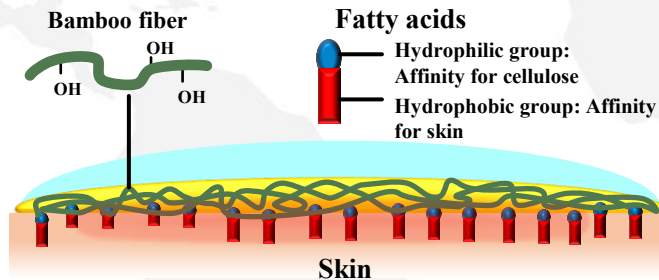
The fatty acid level was optimized, as too little led to insufficient adhesion, while too much caused surfactant-like behavior.

Study on improving adhesion

Durable film, but insufficient skin adherence

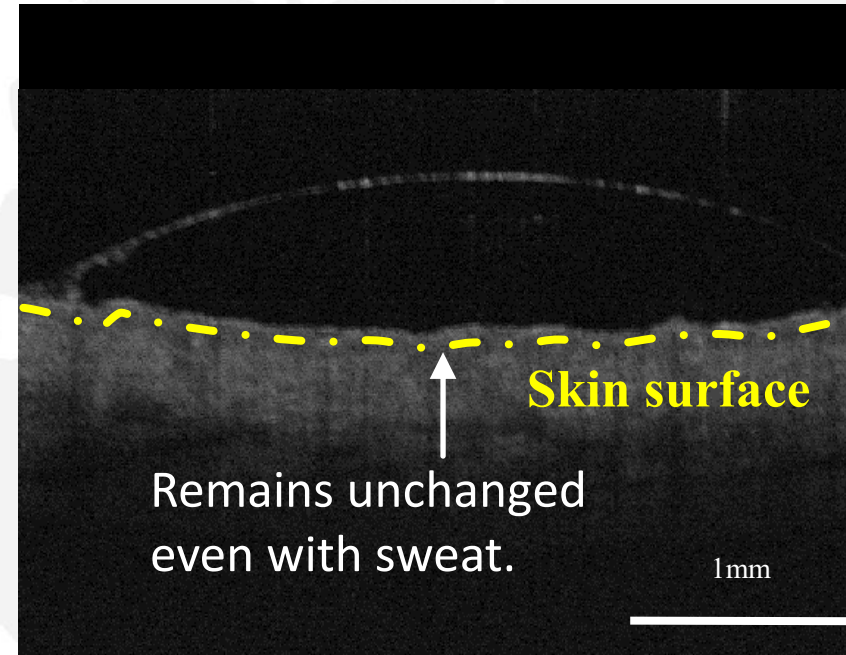
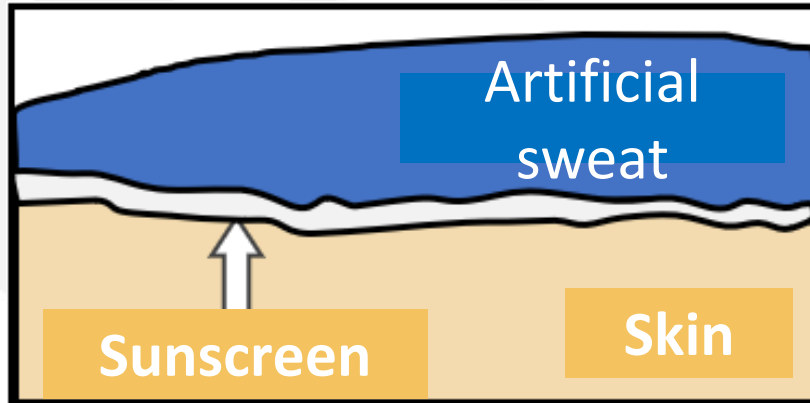


Fatty acids act as anchors, dramatically enhancing skin adhesion



Adhesion was greatly improved by adding a fatty acid.

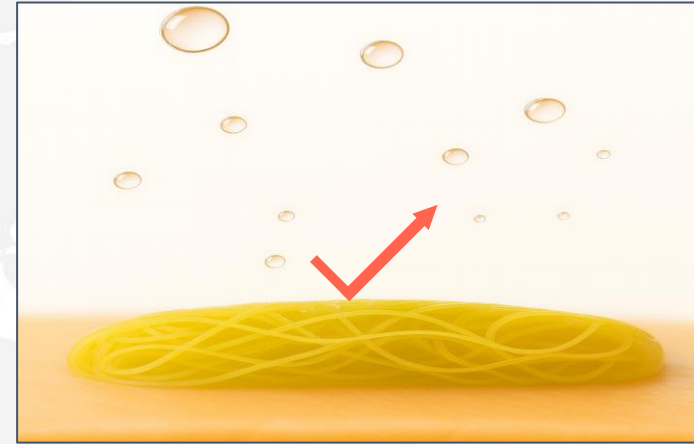
Water-Resistance Performance in Actual Use



The film remains unchanged even with sweat, maintaining its effectiveness.

Conclusion: Differences from Conventional Sunscreens

Advantages Unique to Fiber-Based Emulsification



Fresh, water-bursting texture

49/50 people preferred the fiber-emulsified sample for its freshness and comfort.

Top-level durability

SPF56/UVAPF18 was stable after 80 min of water immersion (*in vivo*, FDA test).

Future Vision

Sunscreen



Skin care



Hair care

