

# Engineering a Sweat Resistant Anti-fog Coating

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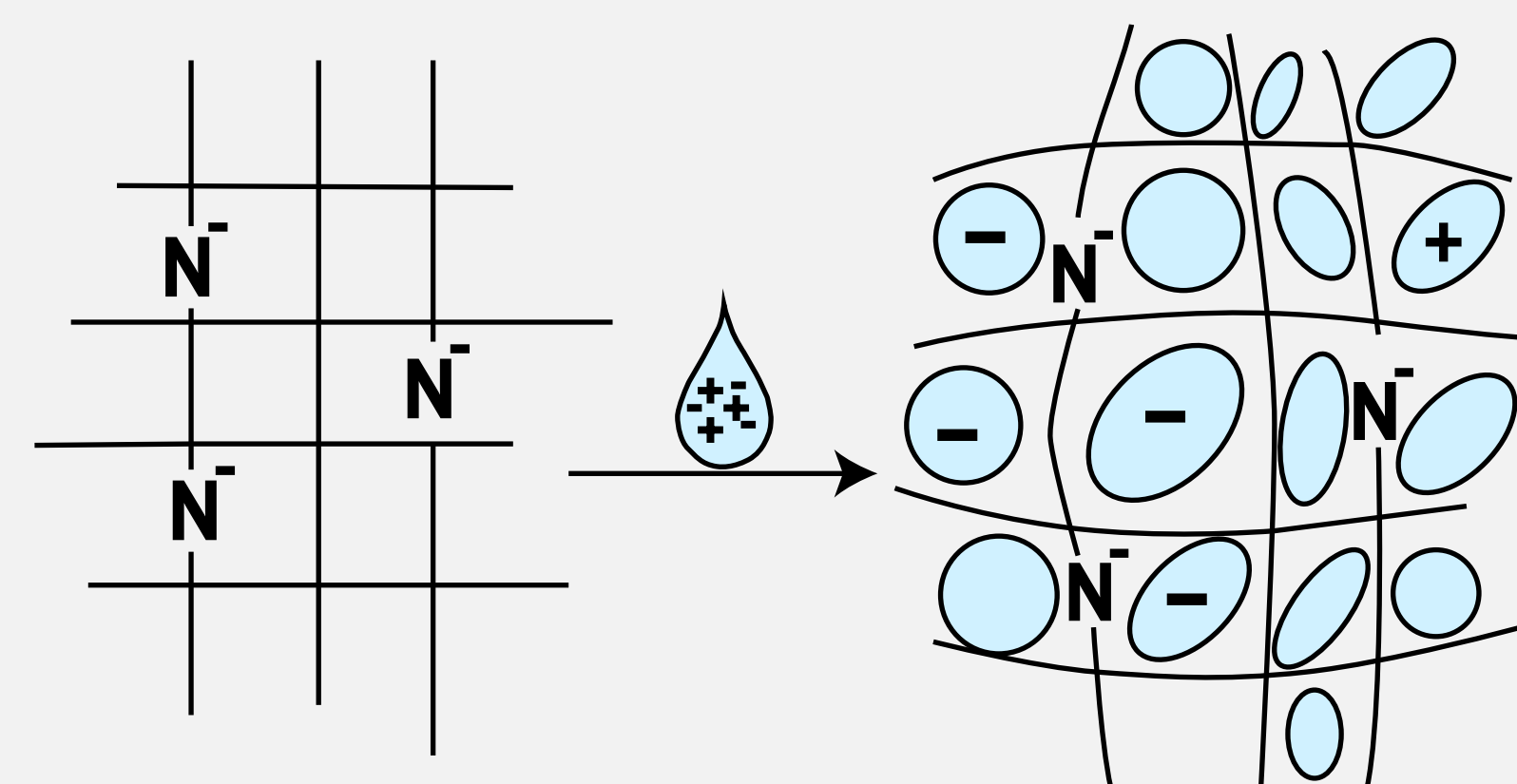
Goggles are important for safety.



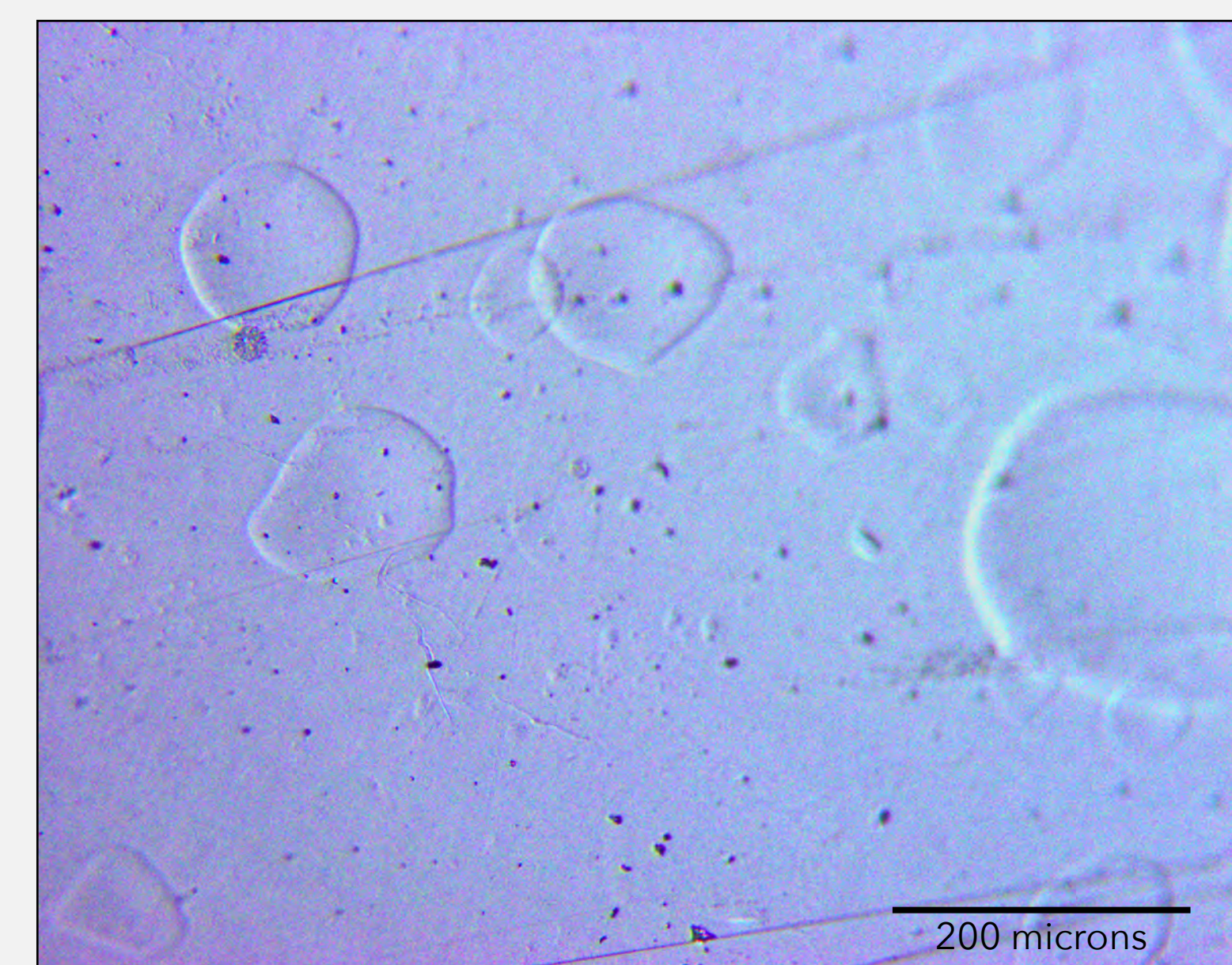
Goggles and face shields are used for both recreational and occupational safety. To maintain proper visibility, it is important that they do not fog over.



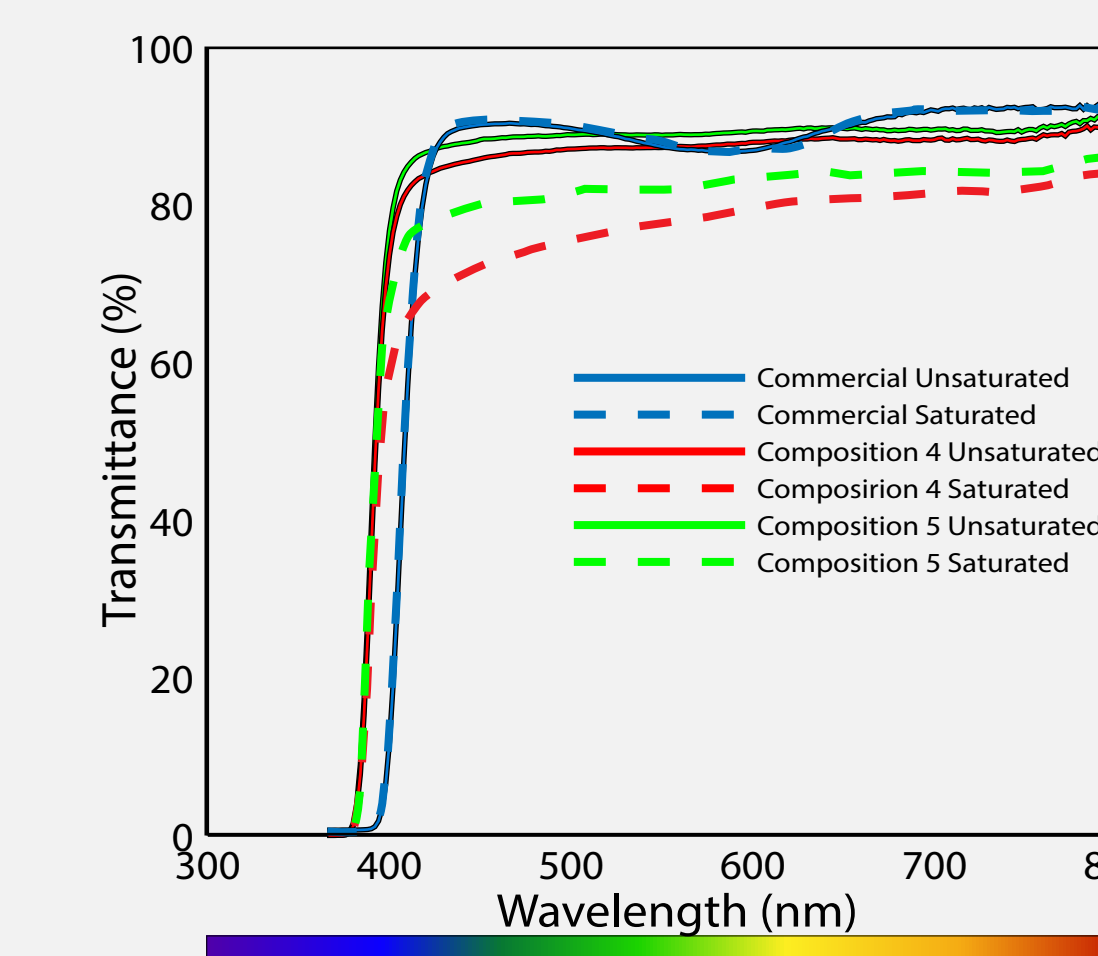
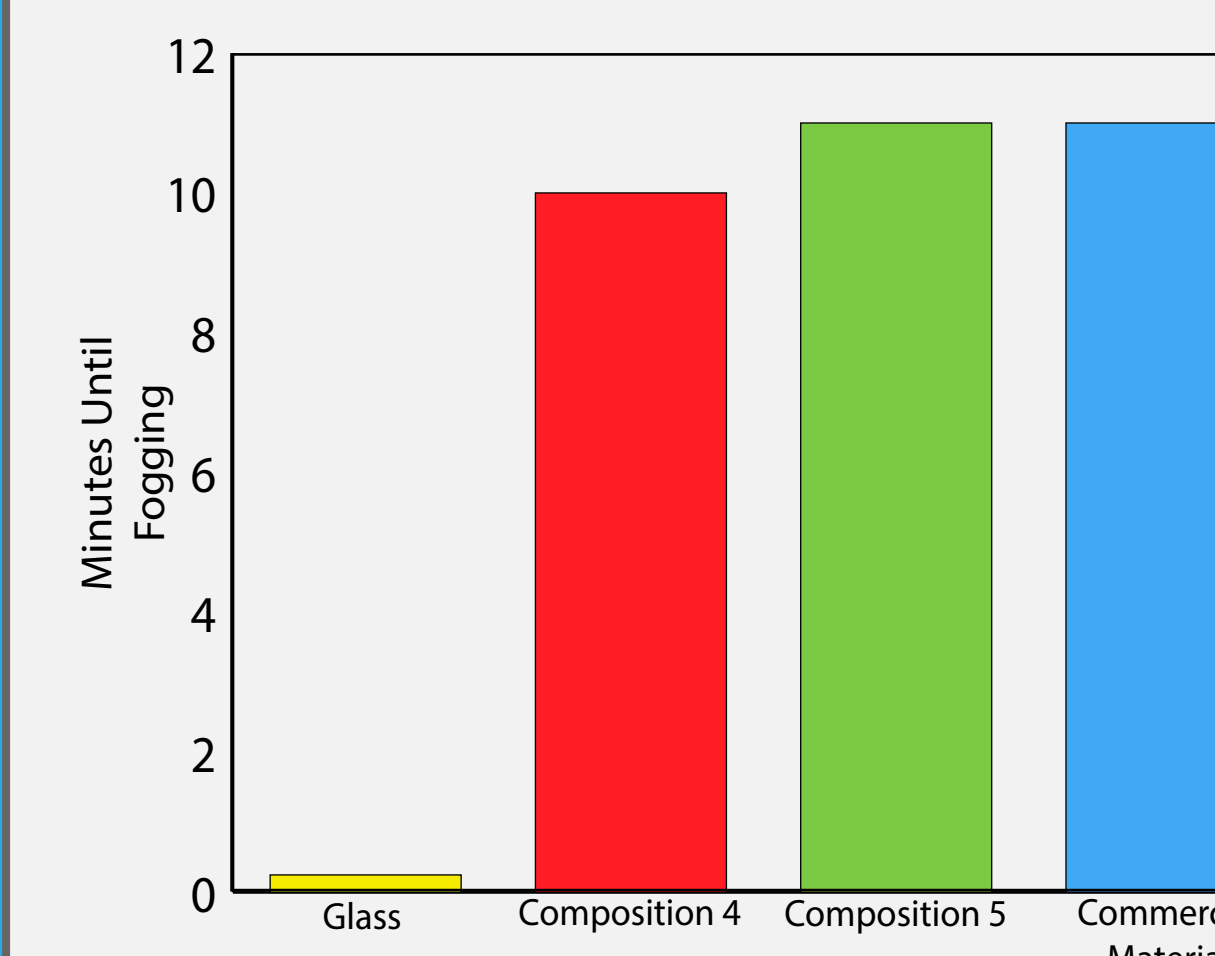
Stippling is caused by nitrogen groups in the molecular structure of hydrogels.



Because nitrogen is electronegative, electrostatic forces cause the structure to swell or contract when ions are absorbed.



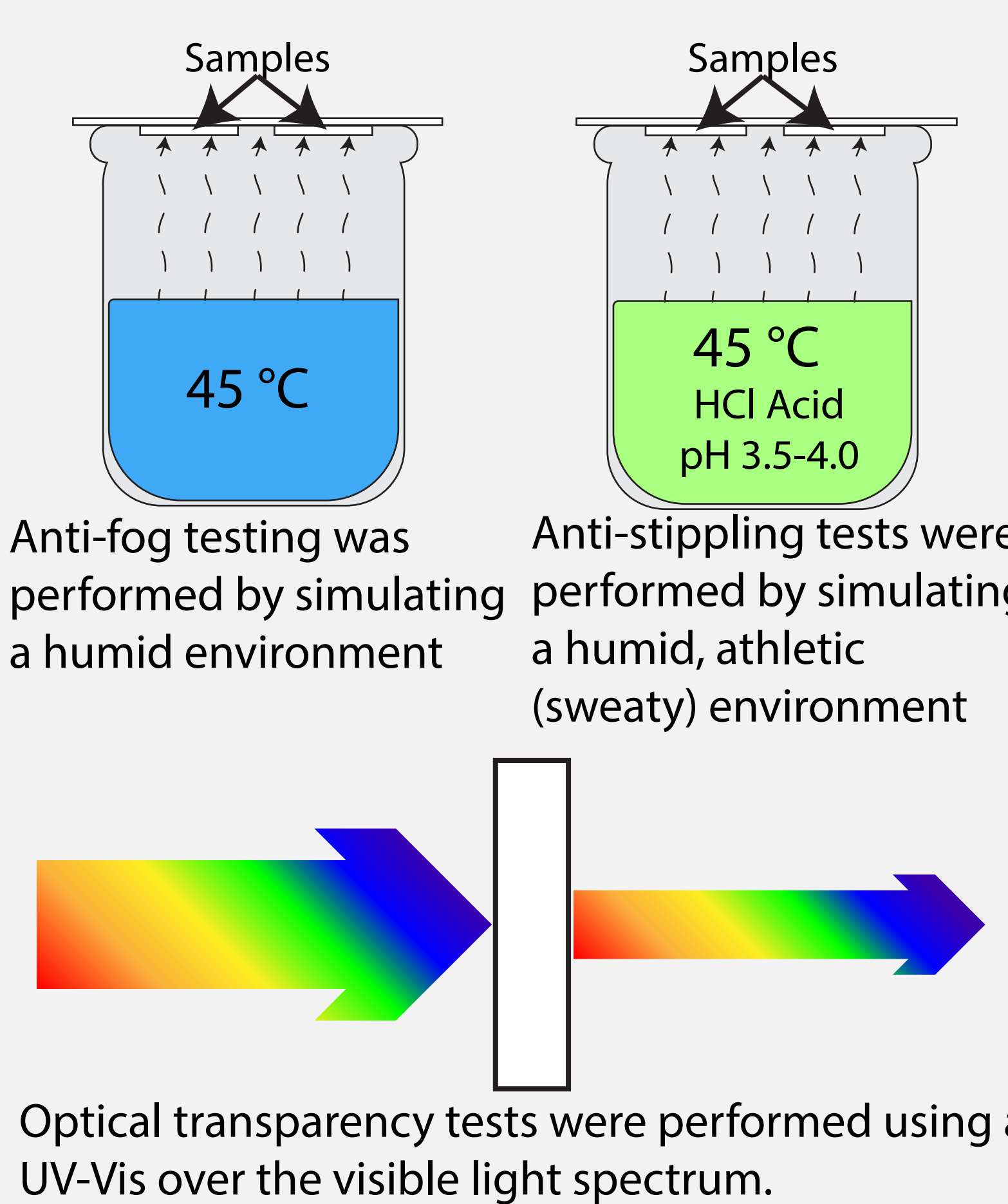
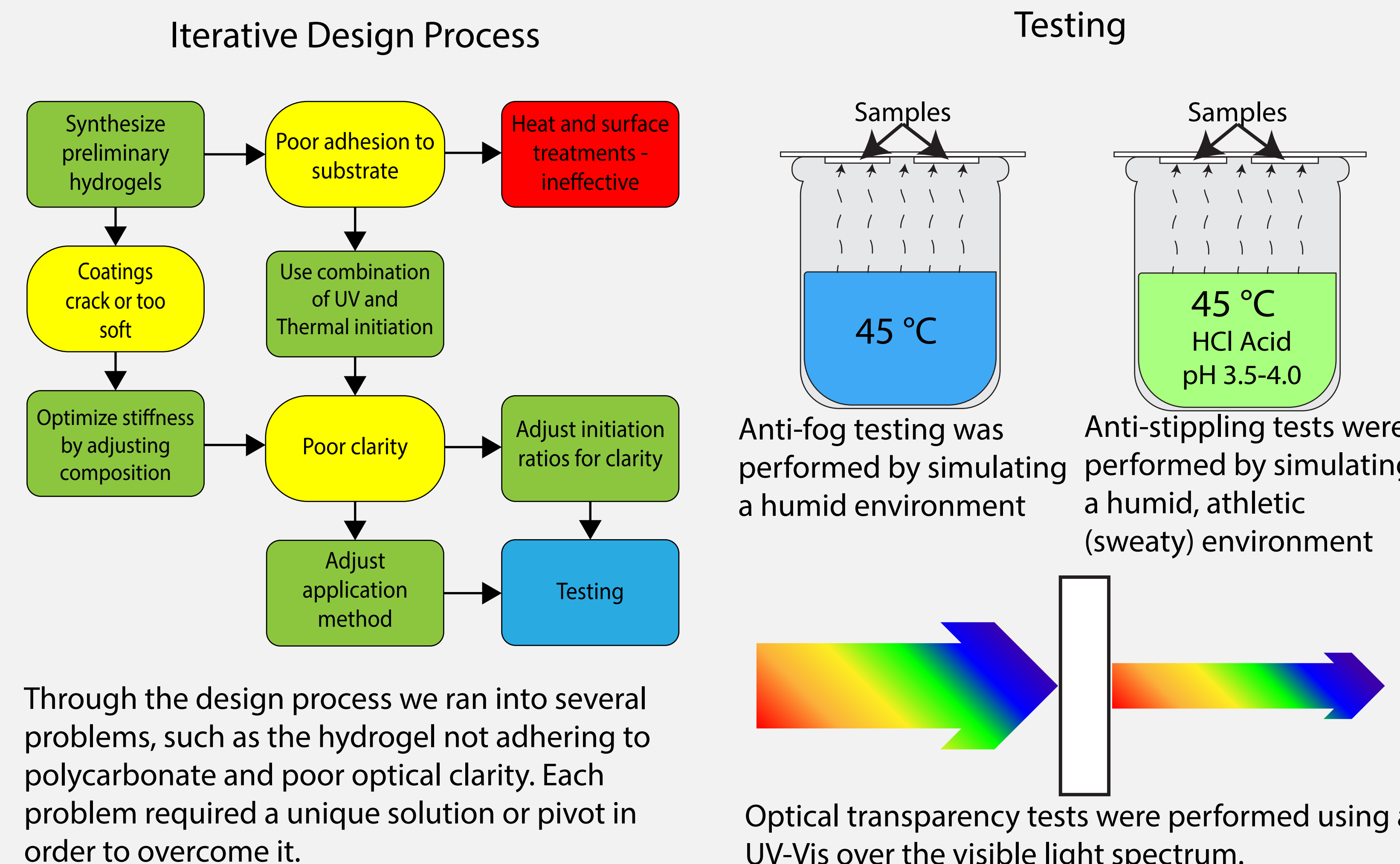
The new anti-fog coating performed similarly to commercial material in both the anti-fog and transparency tests.



Two selected compositions performed similarly to commercial material for anti-fog properties. For comparison, glass fogged over in less than 10 seconds.

In standard conditions, the new coating was nearly as transparent as commercial material. When completely saturated, the new coating became cloudy.

The design process required many iterations and extensive testing.



Several design goals were achieved, but future work must be done before the new coating can be commercialized.

| Goal                     | Achieved?                      |
|--------------------------|--------------------------------|
| Anti-Fog                 | Matched commercial performance |
| Sweat/Chemical Resistant | Tests inconclusive             |
| Polycarbonate compatible | Adheres well                   |
| Optically Clear          | Need new application method    |
| No Deterioration         | Long-term testing needed       |

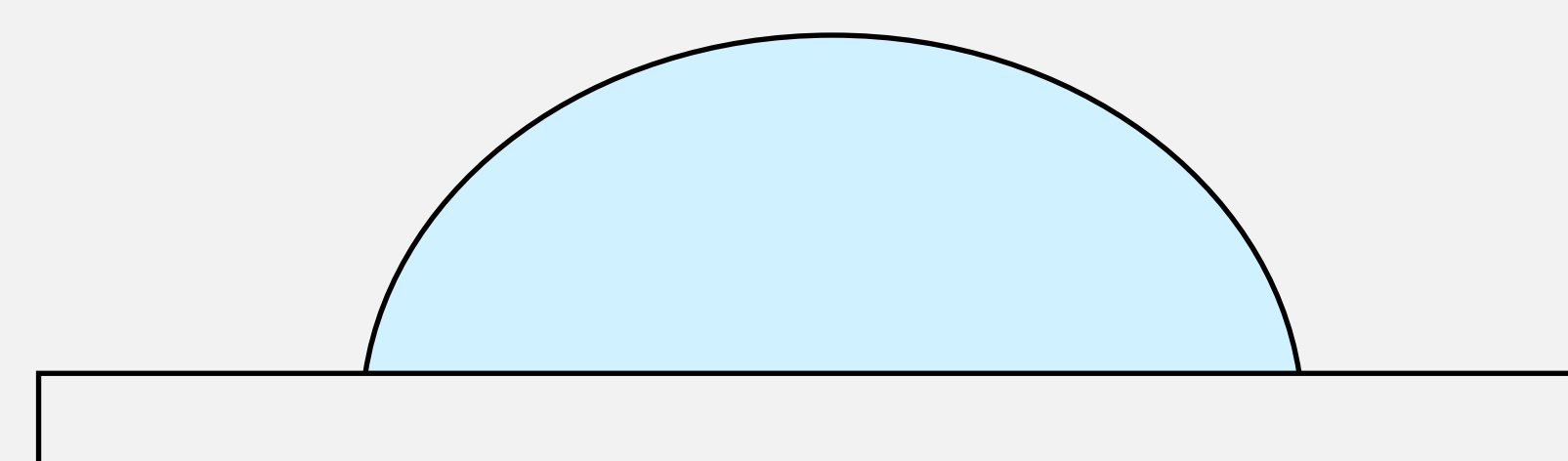
While the new coating performs well in anti-fog tests and has met the requirement of being compatible with polycarbonate, further iterations must be done to verify sweat resistance. A new application method, potentially spin-coating, will likely solve most of the issues.

### Acknowledgements

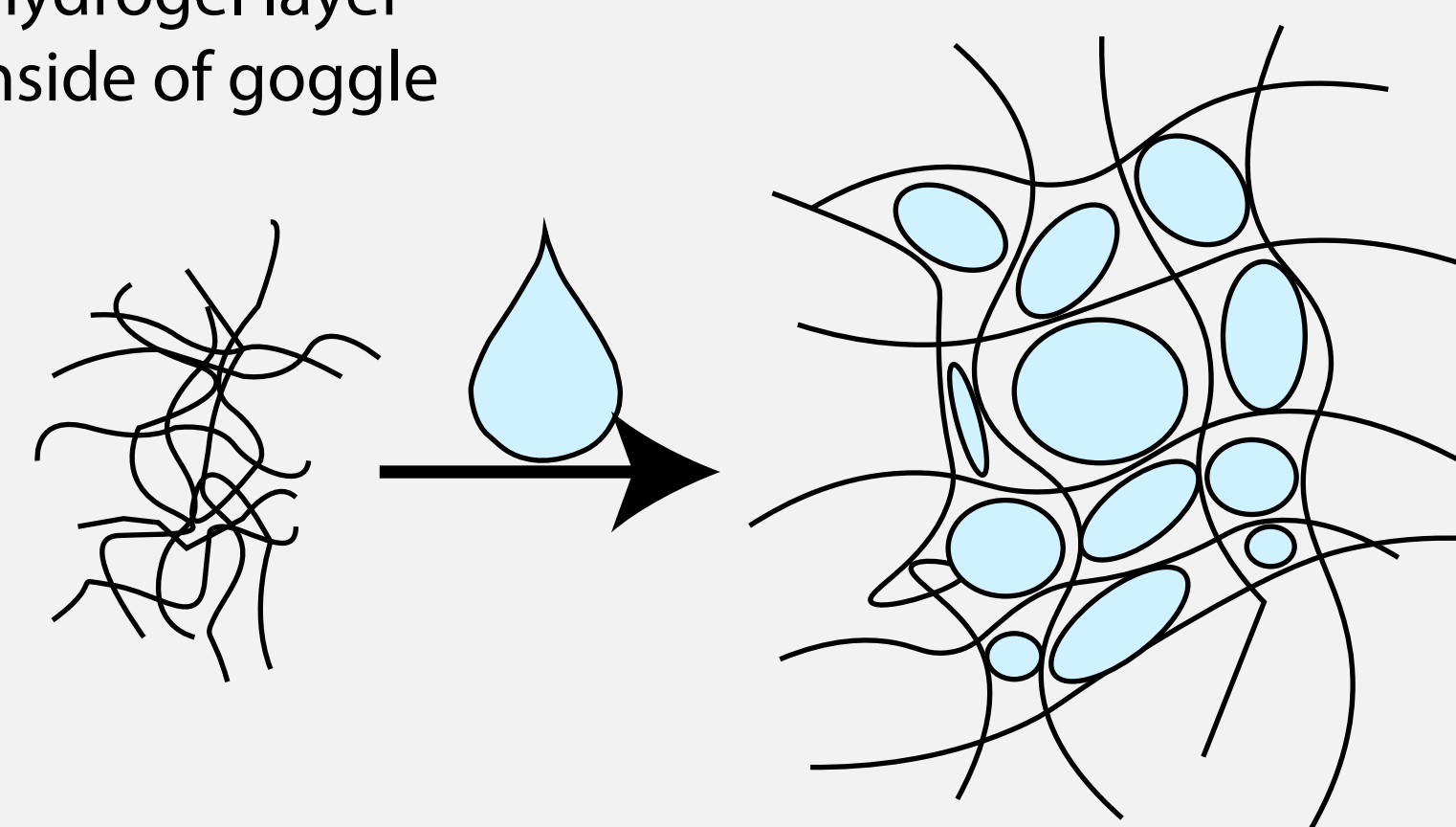
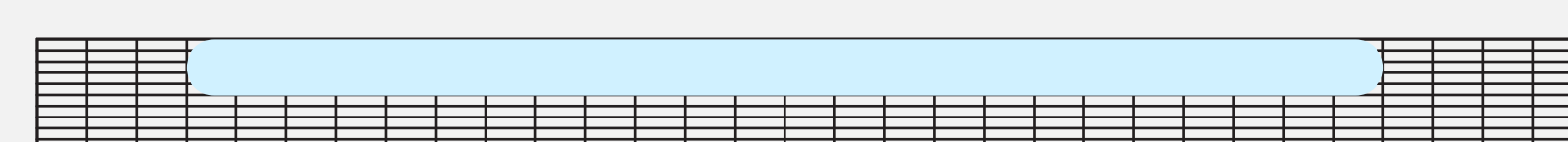
The design team would like to thank Taylor Sparks and Jeff Bates for providing their guidance and expertise. The team would also like to thank Ken Barfield of DFG, Inc. for providing support throughout the project.

Hydrogel anti-fog coatings work well in preventing fogging.

Water condenses easily on smooth surfaces causing fogging.



Hydrogel anti-fog coatings prevent fogging by absorbing water without letting it condense. A thin hydrogel layer is applied to the inside of goggle lenses.



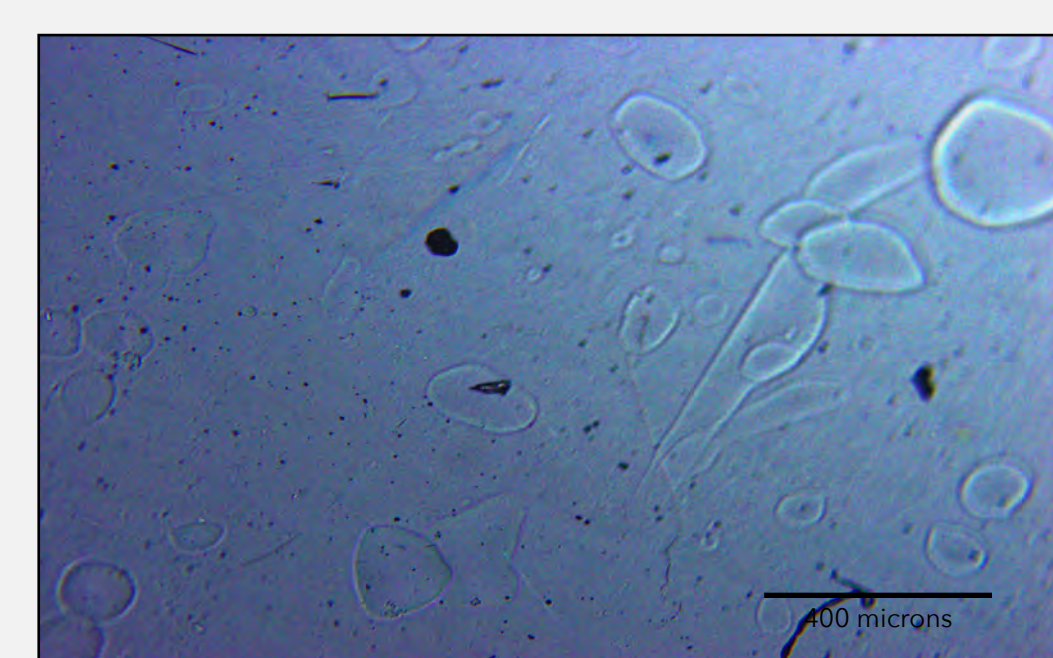
Hydrogels are network polymers which readily absorb water.

Scott Sports has noticed dimpling, also called stippling, on some of their customer's lenses.

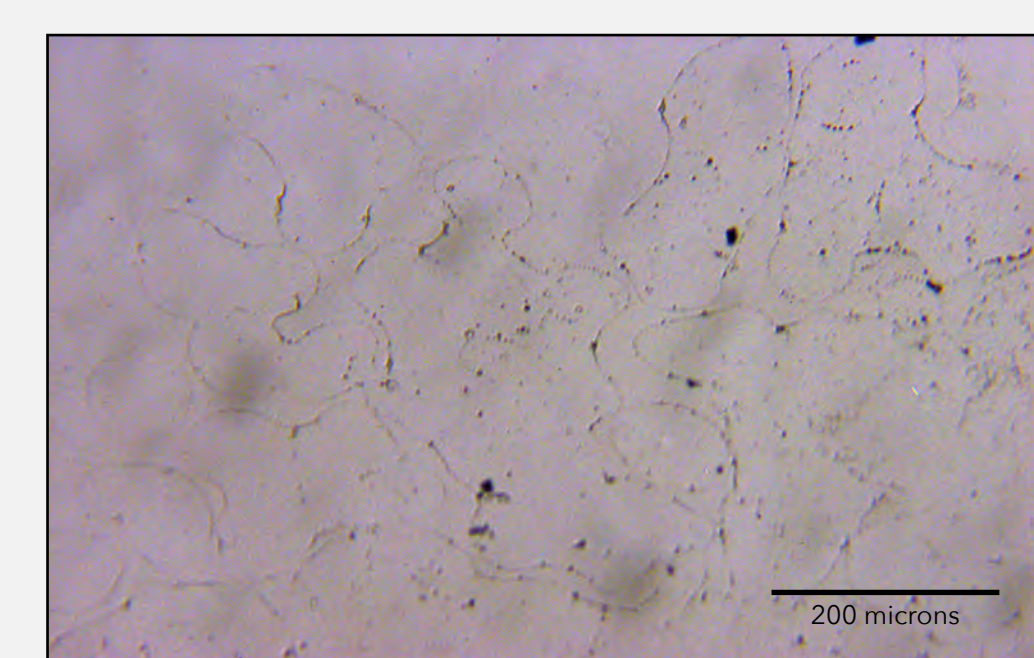


This stippling effect can cause optical distortions, causing a safety issue. It is hypothesized that the acidity of sweat is the root cause of the issue.

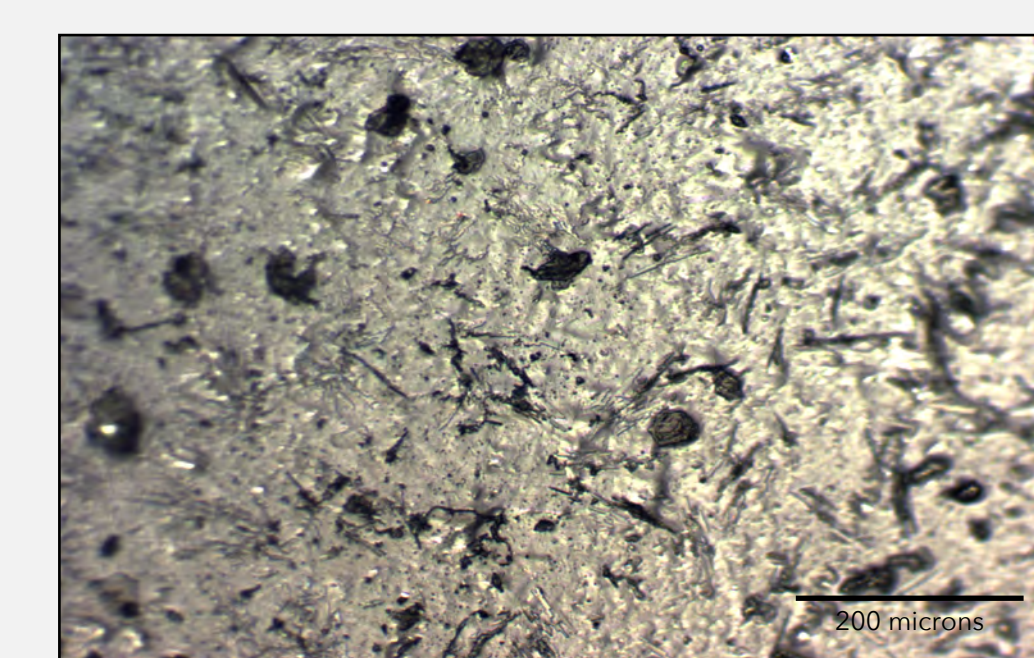
Anti-stippling results were inconclusive due to the roughness of the new coating surface, but a safe method for reproducing stippling was developed.



Stippling from customer-returned lenses was replicated.



The commercial material stippled during the acid test as predicted.



Though the new material appeared to be smooth, microscopically it was too rough to discern whether or not it stippled.