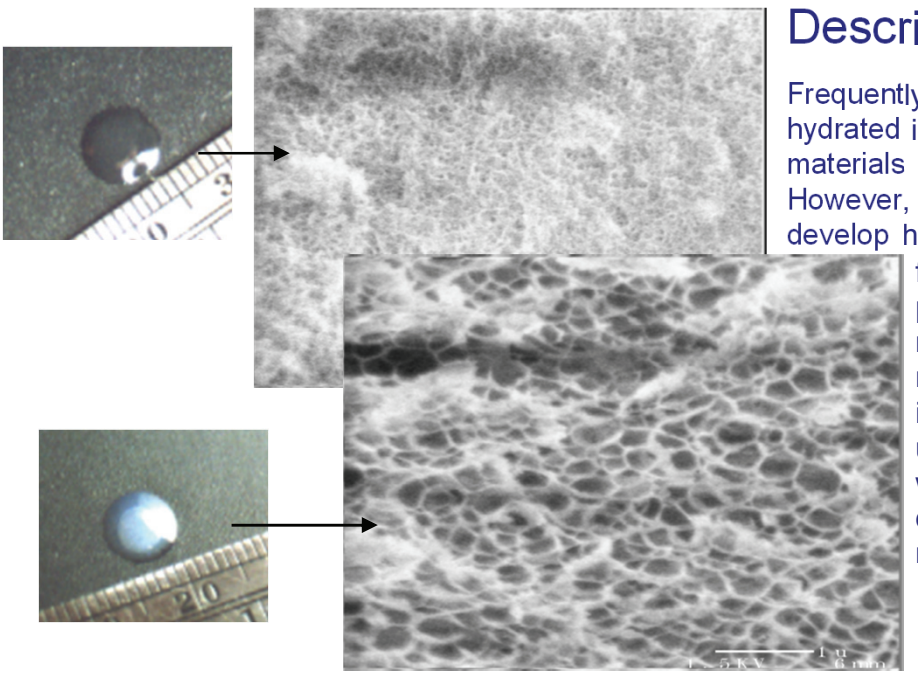
Artificial lens hazing root-cause analysis

Summary

Intraocular lenses (IOL) are often implanted as a replacement for cataract-damaged lenses, or in some cases to change the optical power of the lens. These lenses were originally made from poly(methyl methacrylate) (PMMA) but are now often silicone and acrylic. The ideal material for this application is one that has the relevant optical power but is soft and pliable allowing a minimal incision. A client of Cambridge Polymer Group came to us with concerns over hazing that was occurring in a new formulation of lenses during manufacture.

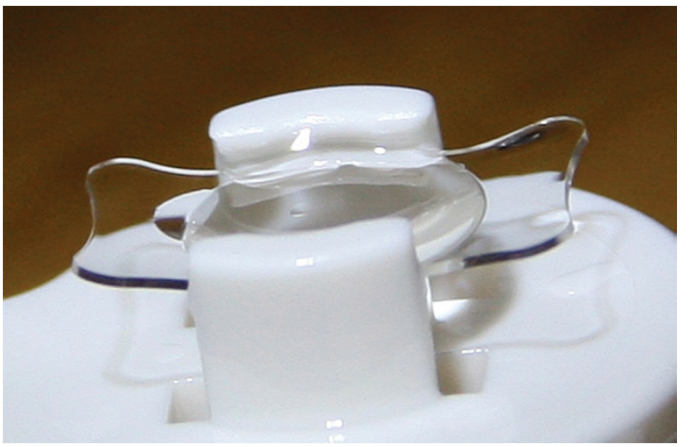


Description

Frequently, traditional IOL's were not designed to be hydrated in use and were composed of impermeable materials such as PMMA and silicone rubbers. However, later versions are increasingly attempting to develop hydrophilic materials that are more relevant for the human body. Conventional polymerization processes are in general random and poorly controlled resulting in microstructures that can often lead to non-ideal optical properties. In particular, if the underlying polymers are too "blocky" they will tend to phase separate in larger domains that can readily scatter light, rendering the lens opaque and useless.

Analysis

Cambridge Polymer Group performed root-cause analysis on samples provided by the client. Through an extensive and complex testing procedure staining, drying, deformation and direct microstructure visualization using SEM, the cause of the cloudiness was traced to a poorly controlled reaction process resulting in microcavitation within the lens during the swelling process as the lens hydrated.



Key points

- Understanding the underlying chemistry of the process, as well as the basic physics involved is critical to solving many interdisciplinary problems
- Complex problems are rarely solved without a range of analytical tools and the skills to use them effectively

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