

Captive bubble method in contact lens studies

This application note illustrates how the Attension Theta Optical Tensiometer and captive bubble method can be utilized in contact lens studies.

Introduction

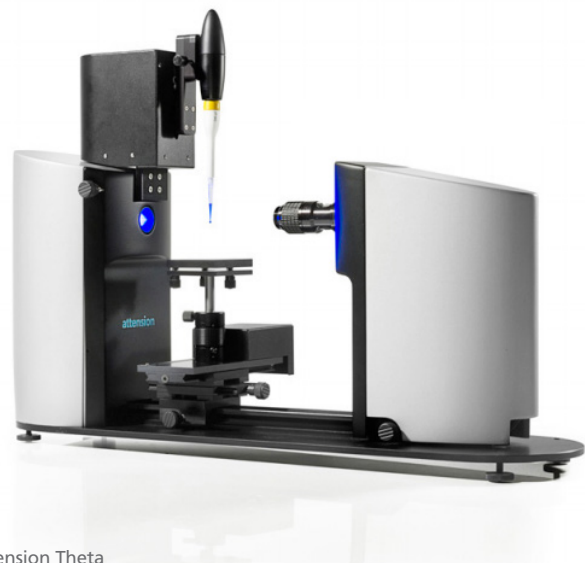
Contact lenses are widely used and hydrogel contact lenses are the most prescribed type of contact lenses around the world. Hydrogel lenses are made from hydrophilic polymers, such as polyhydroxyethyl. Contact lenses should have certain characteristics to avoid discomfort during wear. These include an adequate oxygen permeability, lens motion and surface wettability. A fairly recently discovered material for contact lens manufacturing is the silicone hydrogel, which is suitable for long term use as it has improved oxygen delivery on the ocular surface. However, this material has been reported to have reduced wettability compared to the other materials used in hydrogel contact lenses. The wettability of a lens is measured of the ability of the lens to support a continuous and rupture-resistant tear film on its surface. A lens with a limited wettability is uncomfortable and has a reduced visual performance. Therefore it has been a major investment for the contact lens industry to develop a soft lens surface that is highly wettable in the ocular environment. Captive bubble method is a very useful tool to examine the advancing and receding contact angle as it is possible to maintain fully hydrated conditions on the lens surface during the experiment. This is essential to mimic the real situation properly. In Figure 1 the contact angle of an air bubble in water is obtained with the captive bubble method and it is calculated to be 40°. In highly water wetting lenses the contact angle hysteresis is eliminated and both the advancing and receding contact angles approach zero.

Case study: Contact angle measurements on contact lens surface

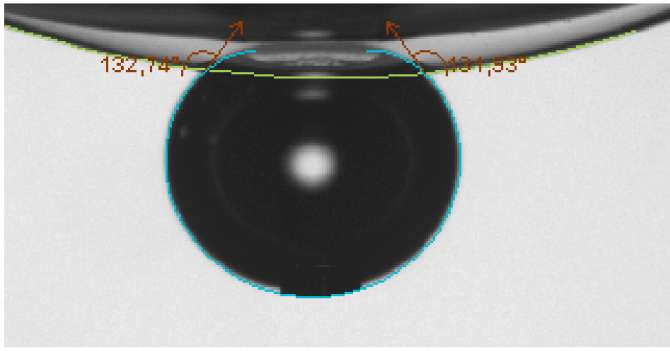
In the captive bubble method the contact angle is measured by placing a bubble of air onto the lens surface with a capillary while the lens is immersed in a liquid. Preferably the lens should be soaked in liquid for a couple days before the measurement

takes place in order to get the lens fully wet. The conditions in this experiment should mimic in vivo conditions as well as possible, meaning that the liquid used in the contact angle experiments should be close to the real nature of a tear film in the eye. The tear film is composed of surface active components such as mucin and lysozyme.

Receding and advancing contact angles are both important measures of contact lens wettability. A receding angle forms as the water phase moves away from the capillary. This corresponds to the situation when the eyelid is open and the tear film starts rupturing on the lens. The advancing contact angle develops as the water phase moves towards the capillary. This is the case when the eyelid closes and the tear film on the lens starts to recover.



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[Figure 1]: Air bubble on contact lens surface

Conclusion

With captive bubble method contact angles of lenses can be measured in different solutions to obtain the most ideal solution that wets the lens best. Some have reported that significant change can't be seen in whether the solution is pure water or a liquid containing surfactants, like the contact lens solutions on the market. Also studies of different coatings to improve the lens wettability have been made. Protein coatings have found to be successful in improving the wettability of contact lenses. Protein coatings resist the tear protein adsorption and deposition into the lens.

References:

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