Área: ELE

Using Scanning Electrochemical Microscopy for Localized Oxygen Permeability Monitoring in Contact Lenses

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Highlights

- The cornea relies on oxygen diffusion; contact lenses can limit this, causing potential eye complications.
- SECM maps oxygen permeability in contact lenses with high-resolution.
- Variations in material, thickness, and aging impact oxygen transmission in lenses.
- Pigments in lenses affect oxygen permeability, influencing eye health.
- Findings guide safer lens design, optimizing comfort, wear time, and replacement.

Resumo/Abstract

As a non-vascularized tissue, the cornea relies on atmospheric oxygen to sustain its metabolic processes. Reduced oxygen availability can lead to corneal edema and impair the eye's natural defense mechanisms. Contact lenses can act as a barrier to oxygen diffusion, potentially causing complications such as swelling, limbal redness, epithelial thinning, and microcyst formation. Therefore, oxygen permeability (Dk) is a critical factor for user safety and comfort, directly influencing adaptation time and the risk of corneal hypoxia.

This study employs Scanning Electrochemical Microscopy (SECM) to monitor, with high spatial resolution, the oxygen permeability through contact lenses. In the SECM experiments, a microelectrode was positioned 5 µm from the lens surface to map oxygen diffusion precisely. This proximity allows for detailed spatial quantification of oxygen transport across different lens regions, enabling the identification of variations related to material composition, thickness, and potential changes over time.

The impact of pigments presented in colored lenses on oxygen permeability was also examined. The findings may provide valuable guidelines for developing safer lenses, balancing functionality and ocular health, and refining recommendations for wear duration and replacement schedules.

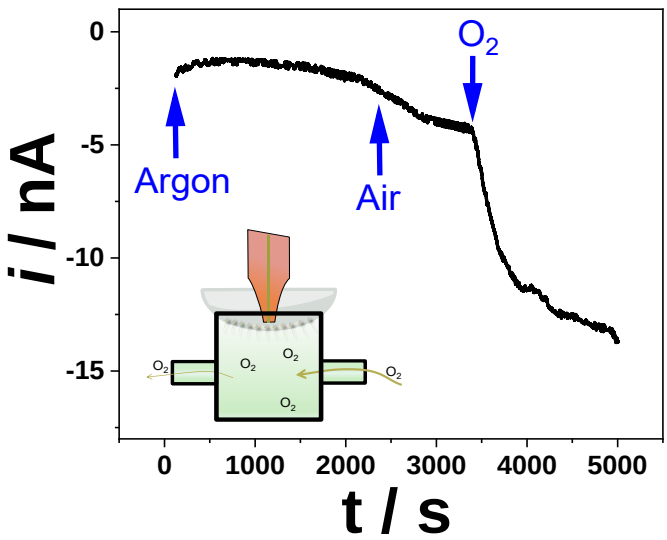

Figure 1 - Amperometric monitoring of oxygen gas permeability through a contact lens using Scanning Electrochemical Microscopy (SECM). Argon, air, and oxygen were injected into the donor compartment, which was separated from the receptor compartment by a contact lens (schematic shown in the inset). A microelectrode was positioned 5 µm from the lens surface in the receptor compartment, containing a 0.5 mM ferrocyanide + 0.1 M KCl solution, and held at a potential of -0.7 V.

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