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Engineering controlled release of therapeutics and comfort agents from novel therapeutic contact lenses

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It is an exciting time within the field of ophthalmic drug administration, with new methods of delivery showing tremendous promise. The 'go to' products are topical eye drops, which are grossly inefficient delivery vehicles that hold 90% of the ocular pharmaceutics market. With a market valued at ~$15 billion and growing at an 8-10% compound annual growth rate, there is a substantial opportunity for the commercialization of new products that deliver therapeutics more effectively and efficiently to the eye. The creation of enhanced ocular delivery systems has tremendous promise to profoundly impact ocular health via improved treatment options, which will greatly improve quality of life.

This presentation will involve a discussion of the challenges and opportunities associated with ocular delivery and one of the most recent novel drug delivery materials, therapeutic contact lenses. Within my research group, we have created a platform technology and a number of novel contact lenses with controlled transport of various therapeutics that can deliver constant amounts of medication to the eye for the duration of lens wear from days to weeks. In comparison, topical eye drops were ~100 times less effective when tested *in vivo*. Strict control of release is accomplished by engineering the architectural design of biomaterials at the molecular level. Characterization analysis of the network structure of the network in terms of molecular weight between crosslinking points, mesh size, and diffusion studies provides an aid to optimizing the design and begins to answer fundamental questions on the nature of the release control and extended delivery on the chain level. Our research also includes more comfortable and healthy contact lenses, by the controlled release of wettability/comfort agents, which is also one of the most important challenges within the lens industry.

Biography

Mark E. Byrne is the Daniel F. & Josephine Breeden Distinguished Associate Professor at Auburn University and co-founder/CTO of OcuMedic, Inc., a drug delivery company in Auburn, AL. Byrne is a leader in the field of biomaterials engineering, controlled therapeutic delivery, polymer engineering, and biomedical devices. He has made significant and sustained contributions to the field of ocular drug delivery and is a pioneer in the evolving field of contact lens delivery. His group was the first to demonstrate controlled and extended release of therapeutics from novel contact lenses based on a rational design strategy of macromolecular memory of flexible polymer chains, via a fundamental analysis of biological mechanisms of action. In 2011, he published groundbreaking results and the first *in vivo* evidence that a steady, effective concentration of drug can be maintained in the tear film from a contact lens for the entire duration of lens wear (*J Control Release*, 157(3):391-397, 2012). The current standard of care, eye drops, had ~100 times less bioavailability. During his nine years on the Auburn faculty, he has won numerous awards for his teaching and research, licensed a number of technologies, and his research work has appeared in the popular press and television on a number of occasions. Byrne has published over 75 peer-reviewed publications and has given over 200 scientific conference presentations and invited lectures at companies, universities, and international meetings, and he is an inventor on 8 issued patents (with another 4 pending). In 2011, for his contributions to the field, Byrne was inducted as a Fellow in the American Institute for Medical & Biological Engineering (AIMBE). He has held a number of leadership roles in professional organizations and currently serves on four editorial boards. He has also developed and organized over 45 scientific and technical sessions at national and international conferences, including the US National Academy of Engineering. At Auburn, his work has been funded by numerous government agencies including NIH and NSF, and he teaches both graduate and undergraduate courses as well as directs a US Department of Education Program in Biological & Pharmaceutical Engineering and an NSF REU Site in Micro/Nano-Structured Materials, Therapeutics, & Devices. Byrne holds a BS in Chemical Engineering/Biomedical Engineering from Carnegie Mellon & MS/Ph.D. degrees in Chemical Engineering from Purdue University.

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