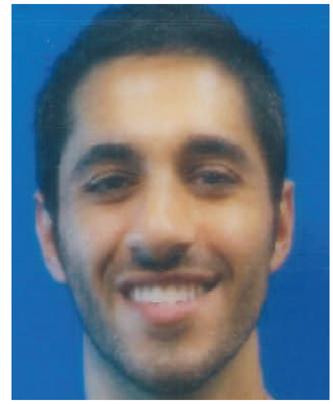
Colloquium
Mechanical Engineering

The Department of Mechanical Engineering presents:

Harish Dixit, Ph.D. Student, BIEN
& Omid Khandan, Ph.D. Student, ME

Friday, January 31, 2014, 11:10AM-12:00PM
Winston Chung Hall 205/206

Omid Khandan



CHARACTERIZATION OF FENESTRATED TITANIUM MICRONEEDLES FOR PASSIVE OCULAR DRUG DELIVERY

Abstract:
A number of current and emerging pharmacological therapies offer means for slowing the progression of leading ocular diseases, such as age-related macular degeneration (AMD), glaucoma, and diabetic retinopathy, thus providing opportunity for preservation of sight in those so afflicted. However, drug delivery to the eye remains a key challenge, due to limitations inherent to prevailing delivery techniques. For example, while topical delivery offers simplicity and safety, its efficacy is often limited by poor bioavailability, due to natural transport barriers (e.g. corneal epithelium) and clearance mechanisms (e.g. tear flow and conjunctival blood flow). Opportunity for delivery via systemic approaches (e.g., oral formulations or parenteral injections) is largely precluded by lack of specificity, which results in undesirable side effects and systemic toxicity. Similarly, while intravitreal injections performed across the ocular tunic provide means for circumventing such limitations, non-negligible potential for retinal detachment and other complications adversely affects safety. Collectively, these limitations demonstrate that development of a safe, simple, and efficacious means for targeted and sustained ocular drug delivery remains a critical unmet need.
Microneedles (MNs) offer significant promise for ocular drug delivery, due in large part to their diminutive size, which allows penetration into, but not through sclera or cornea. This provides a precise, minimally-invasive means for depositing drugs within such tissues. In doing so, MNs enable circumvention of the epithelial transport barrier and conjunctival clearance mechanism, while also minimizing potential for retinal damage. Depositing medication in specific tissue areas, such as the suprachoroidal space, can also be accomplished with greater precision using MNs. This, therefore, provides opportunity for near-optimal balance of safety, simplicity, and efficacy.
Herein, we discuss our initial efforts to address these limitations through development of titanium-based MNs which seek to provide a safer, simpler, and more efficacious means of ocular drug delivery. Devices with in-plane geometry and through-thickness fenestrations that serve as drug reservoirs for passive delivery via diffusive transport from fast-dissolving coatings are demonstrated. Details regarding device design, fabrication, mechanical testing, and coating methods are presented, as are results from coating characterization and insertion testing in ex vivo rabbit cornea.

Biography:

Omid Khandan graduated from the University of California, Davis with a Bachelor's Degree in mechanical engineering and is currently pursuing a PhD in mechanical engineering from the University of California, Riverside. His research focuses on developing novel fenestrated titanium microneedles, which may eventually provide a safe, simple, and efficacious means of delivering drugs to the eye. This work was recently recognized with a best poster award at the Society-Wide Micro and Nano Technology Forum for the 2013 ASME International Mechanical Engineering Congress Exposition, the largest international conference in the mechanical engineering field.