Gold Foams for Biomedical Devices

Erkin Şeker

Department of Electrical & Computer Engineering

November 19, 2013
Motivation: Complex Disorders

Need for tools that can tap into physiology in order to understand and treat disorders
Need: Multifunctional Devices

Monitor  Modulate  Mimic  Conform  Connect

*Advanced nanomaterials and their integration into microdevices has the potential to effectively understand and manage disorders*

E. Şeker © 2011
Nanoporous gold is a promising candidate for multi-functional devices that target various disorders.

**Nanoporous Gold Features**
- Self assembly process
- Integration with microfabrication
- Drug delivery
- Controllable morphology
- Surface functionalization
- Tunable mechanical properties
- Electrical conductivity

Nanoporous Gold - Background

Computational
Erlebacher (2001)

Mechanical
Biener (2006)

Structures
Nyce (2007)

Sensors
Ji (2002)

Depletion gilding
U. Penn. Museum

Actuation
Biener (2009)

Catalysis
Zielasek (2006)

Optical
Liu (2011)

Underexplored
Microsystem Integration
Biomedical Applications
Low-Impedance Multiple Electrode Arrays

Neural Interface Design
Small footprint
Low impedance
High effective surface area

Organotypic brain slices preserve cellular architecture and neural electrical activity.

Hippocampus plays a key role in formation of epileptic activity.
Nanoporous gold electrodes detect both spontaneous and induced epileptic activity in organotypic hippocampus slices with high sensitivity.
Slice Viability on np-Au Array
Electrode Implantation Trauma: Gliosis

• Electrode deterioration
  – Gliosis
  – Increased impedance
  – Reduced signal-to-noise ratio

• Underlying reasons
  – Implantation trauma
  – Foreign body response
  – Micro movement

• Potential remedies
  – Surface modification
  – Drug delivery
  – Flexible electrodes

Need multi-functional interfaces to address biodevice challenges
Organotypic slices exhibit reduced gliosis in response to drug treatment.
Molecular Release from Porous Gold

![Graph showing fluorescein concentration over release time for nanoporous and compact Au](image)
Drug Release & Cell Proliferation

**Acknowledgments**

**Collaborators**
- Prof. Martin Yarmush, HMS
- Prof. Mehmet Toner, HMS
- Prof. Kevin Staley, MGH
- Prof. Matthew Begley, UCSB
- Dr. Yevgeny Berdichevsky, MGH
- Dr. Monika Biener, LLNL
- Prof. Atul Parikh, UCD
- Prof. Bryce Falk, UCD
- Prof. Pamela Lein, UCD
- Prof. Josh Hihath, UCD

**Doctoral Students**
- Özge Kurtuluş
- Chris Chapman
- Pallavi Daggumati
- Tatiana Dorofeeva

**Postdoc**
- Dr. Juan Artés (w/ Prof. Hihath)

**Funding**
- UC Lab Fees Research Program
- UC Davis RISE Grant
- UC Davis Academic Senate Grant
- MGH Fund for Medical Discovery

E. Şeker © 2011
Thank You

Erkin Şeker
Şeker Lab
eseker@ucdavis.edu