

# **Devices and Materials in the Continuous Monitoring of Metabolites**

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# Focus on Glucose

- Costs associated with diabetes (treatment plus losses due to complications, missed work, etc.) to be \$174 billion per year
- Recent studies demonstrate the importance of careful monitoring of blood glucose levels in diabetic patients
  - **40% reduction in microvascular complications** when patients prevented high blood glucose level excursions more effectively

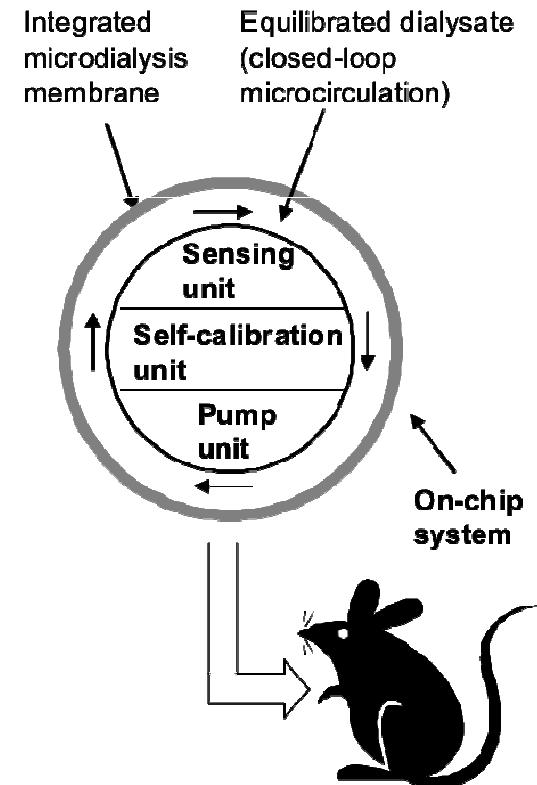
# Motivation

“Implantable glucose sensors have enormous potential, combined with debilitating technical problems. ... No real good alternatives to finger sticks have been developed”



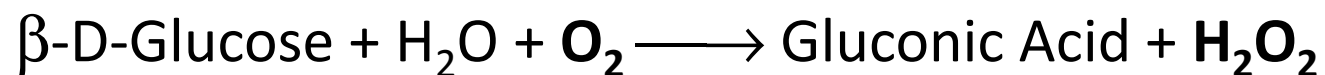
# Long-Term Monitoring of Metabolites

- End goal is an implantable microdevice
- Major challenges
  - Long term stability
    - Is calibration while implanted possible?
    - Degradation of the sensing element?
  - Compatibility with the body
    - Does it produce toxic byproducts?
    - Does the body reject the device?
  - Cost
    - Major convenience, but at what cost?

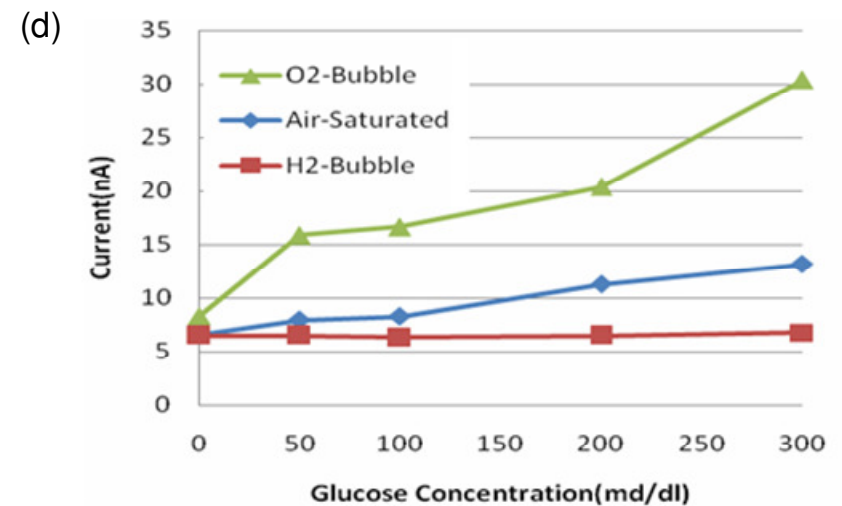
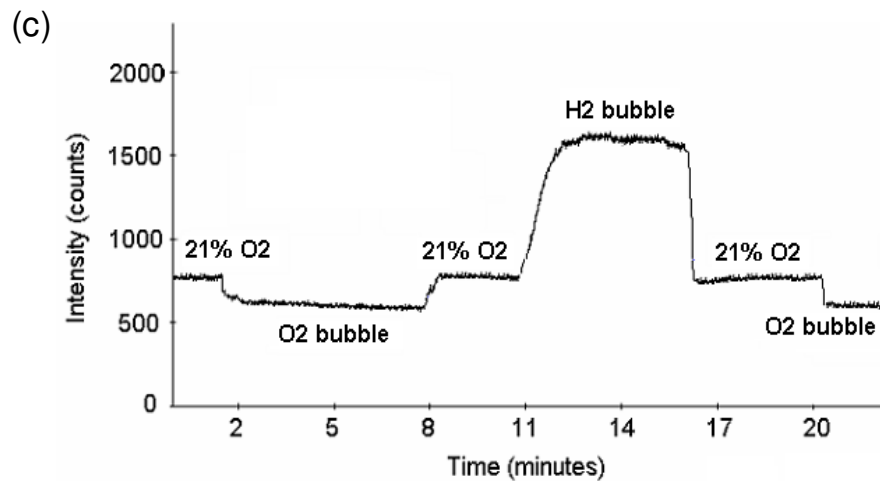
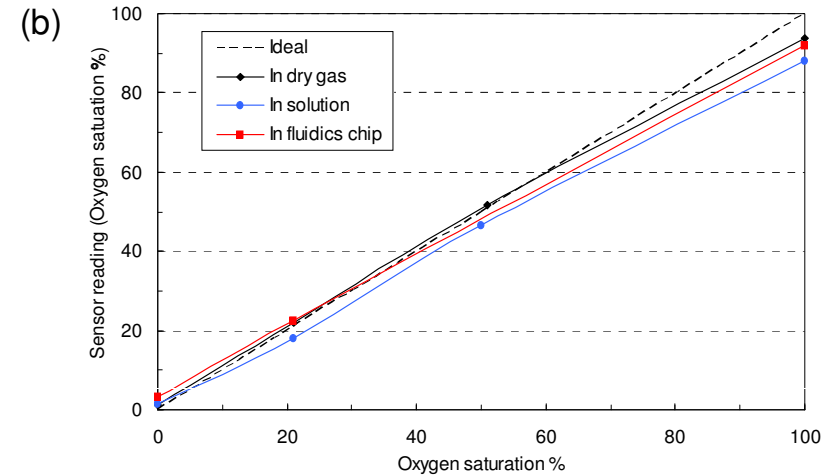
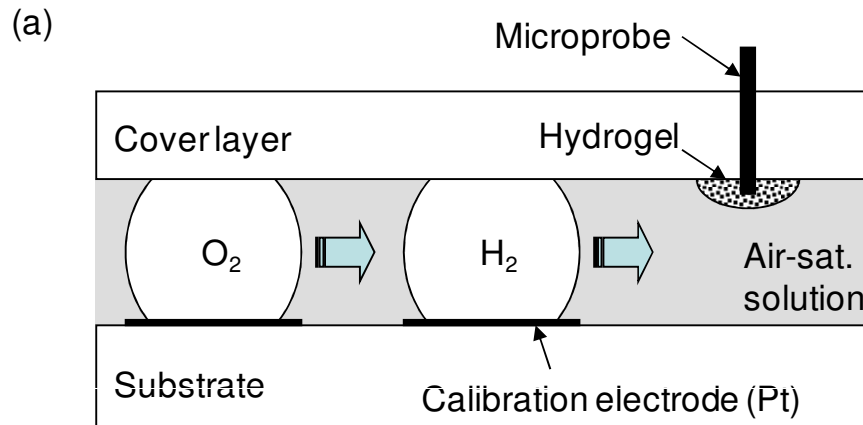


# Sensing glucose: Oxidase Reactions

Glucose oxidase



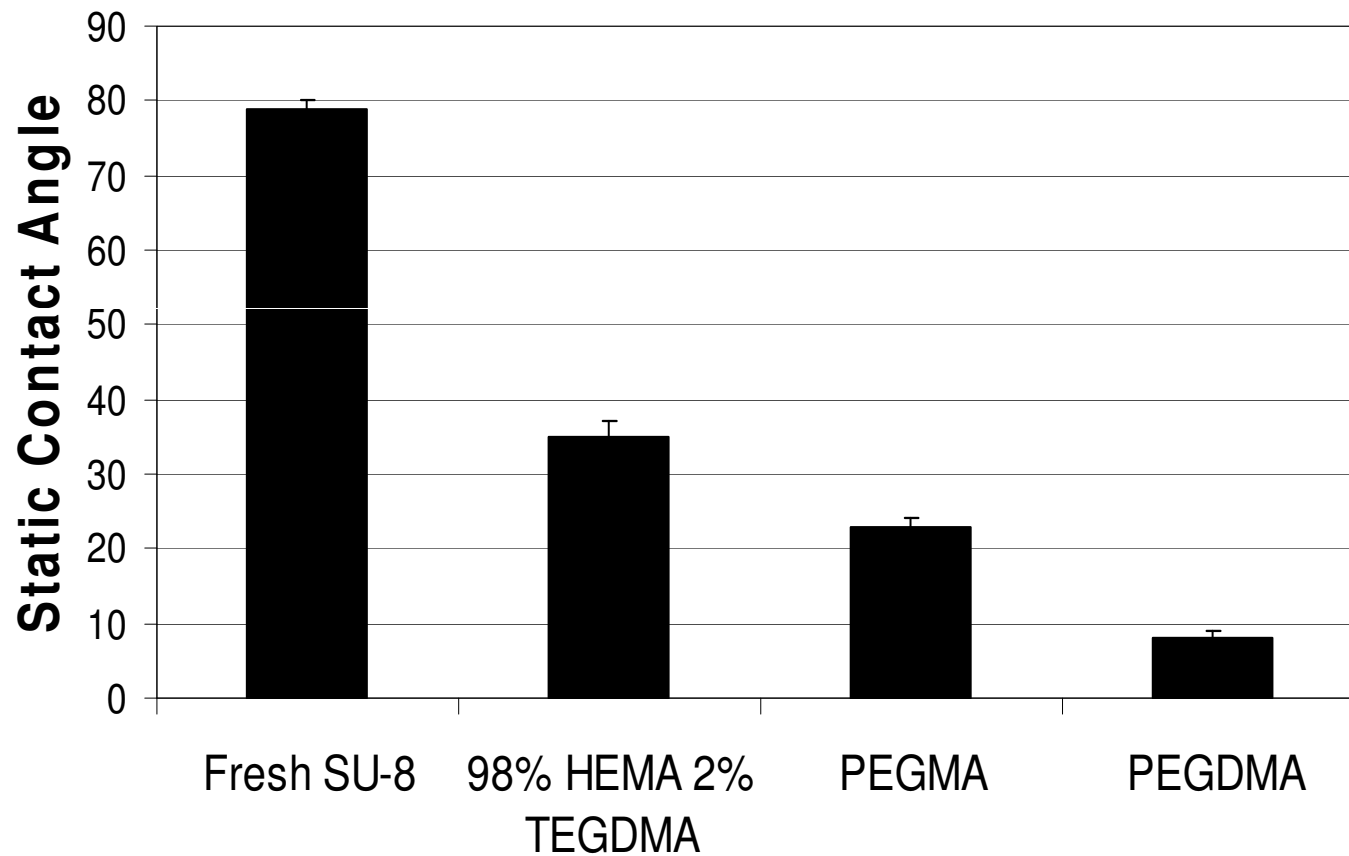
# Long Term Stability



# New Materials

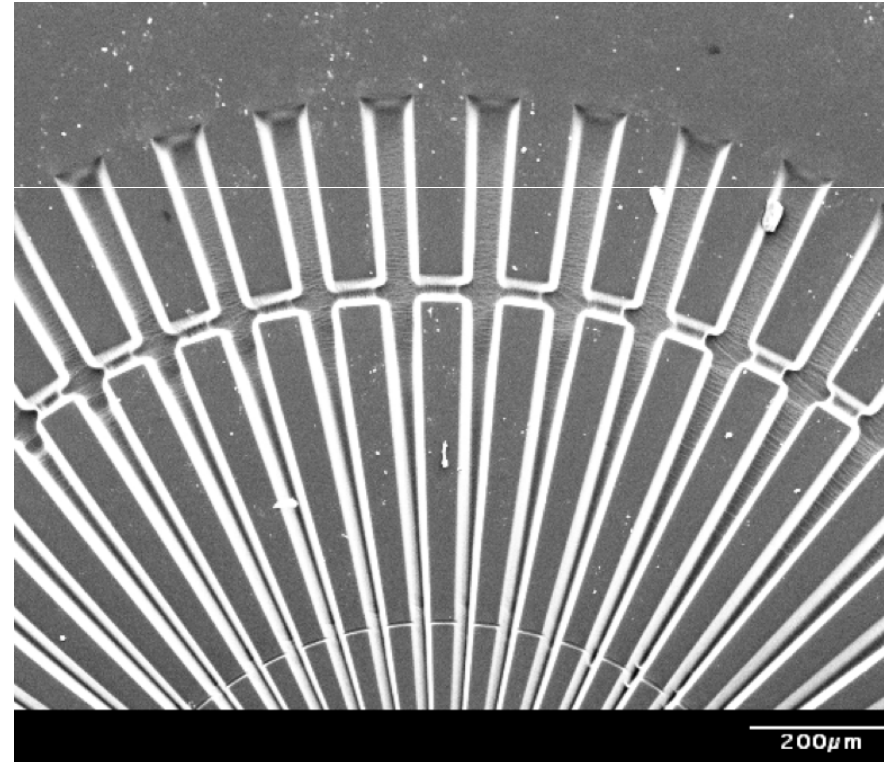
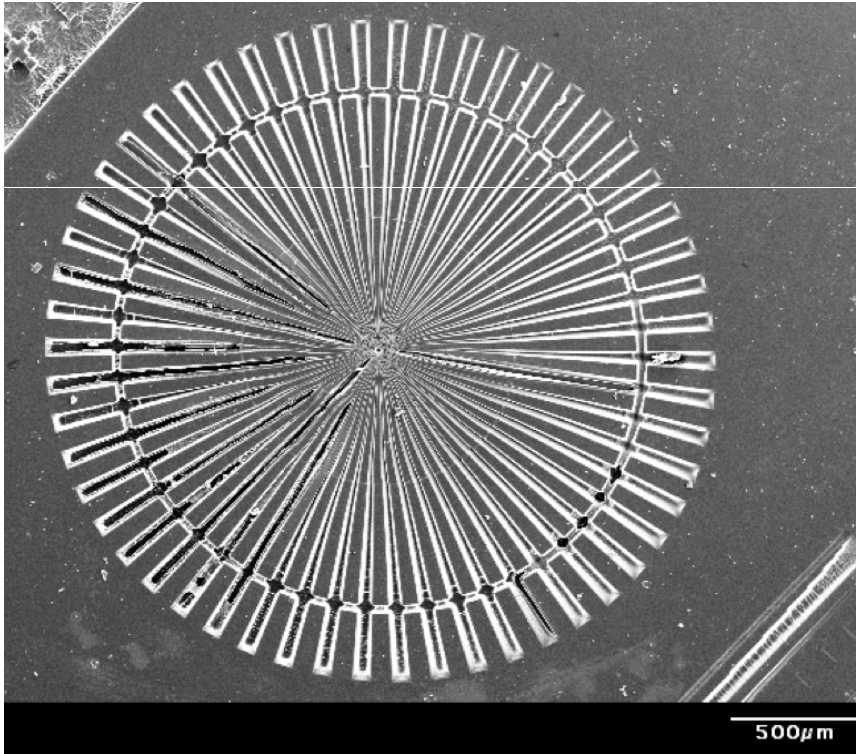
- Traditional microdevices formed from silicon or glass
- Increased use of polymers and plastics as components and structural materials
- Missouri S&T technology to modify these materials for improved biocompatibility
- Amenable to microfabrication techniques
- Move to flexible, inexpensive materials

# Wettability Enhancement

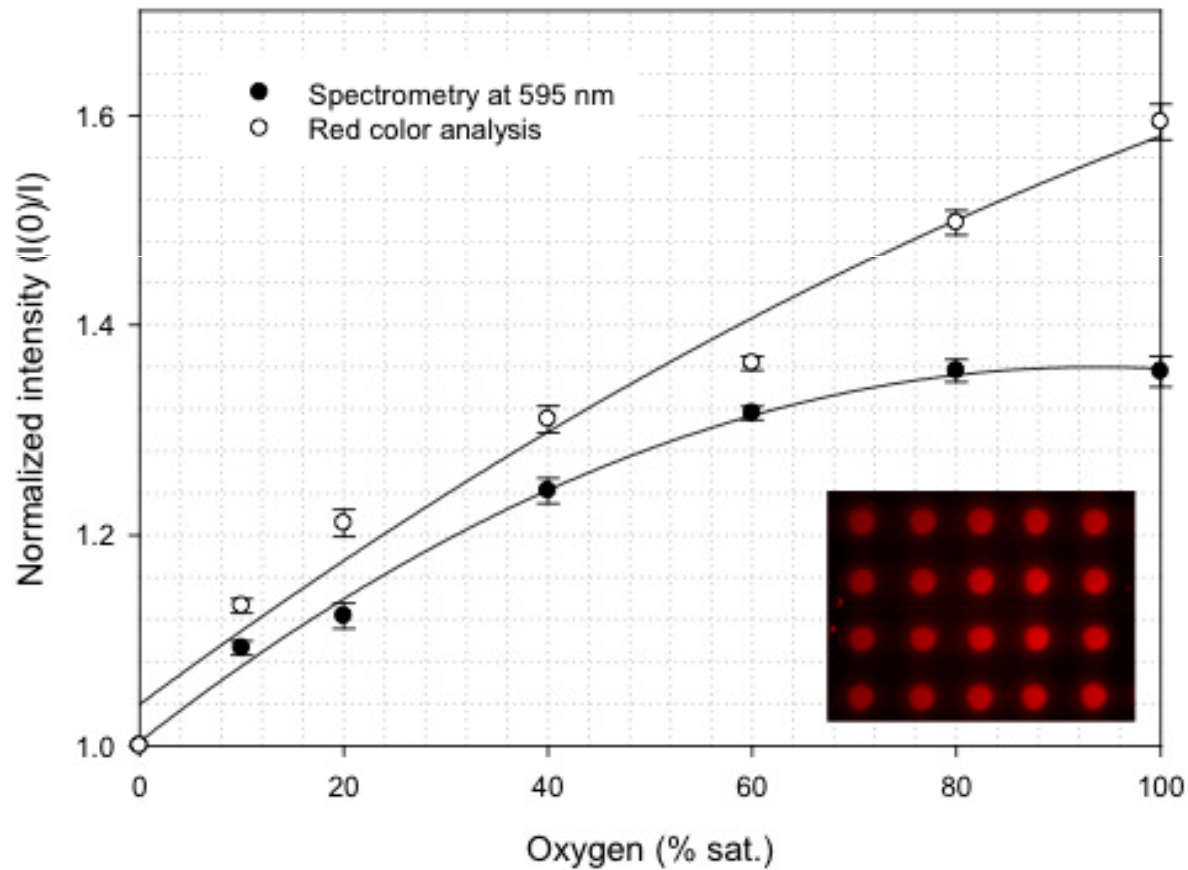




# Photopatternable Grafted Hydrogel Films



# Optical Sensing with Digital Cameras



# Telemedicine

Use of ubiquitous consumer electronics devices to connect patient and physician



## Integration of sensor with electronics

- Use of integrated CCD or CMOS cameras to determine pH, oxygen concentrations, or levels of metabolites
- Wireless technology sends data to physician for interpretation

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  - Missouri S&T Materials Research Center