Investigating Stability of IGZO in Various Solutions

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Objective

To determine the material compatibility of IGZO for use in biometric sensing devices that will encounter bodily fluids of various pH and chemical composition

Background

- Type 1 diabetes is a common chronic condition among Americans
- Utilizing recent developments in glucose sensors is promising for non-invasive monitoring of glucose levels
- Indium gallium zinc oxide (IGZO) can be used as a gate layer in electrical devices and displays
- IGZO field-effect transistors (FETs) are compatible with flexible transparent underlying layers (ex: contact lenses)
- The reaction between glucose and enzymes causes a current charge proportional to glucose concentrations which can be quantified by IGZO-FETs

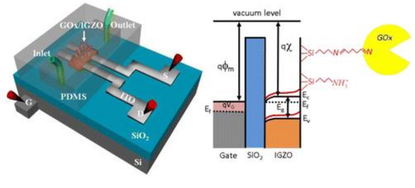
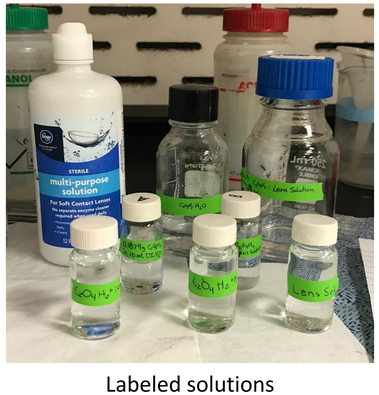


Figure source: Du, Xiaosong, Yajuan Li, Joshua R. Motley, William F. Stickle, and Gregory S. Herman. "Glucose Sensing Using Functionalized Amorphous In–Ga–Zn–O Field-Effect Transistors." *ACS Applied Materials & Interfaces* 8.12 (2016): 7631-637. Web.

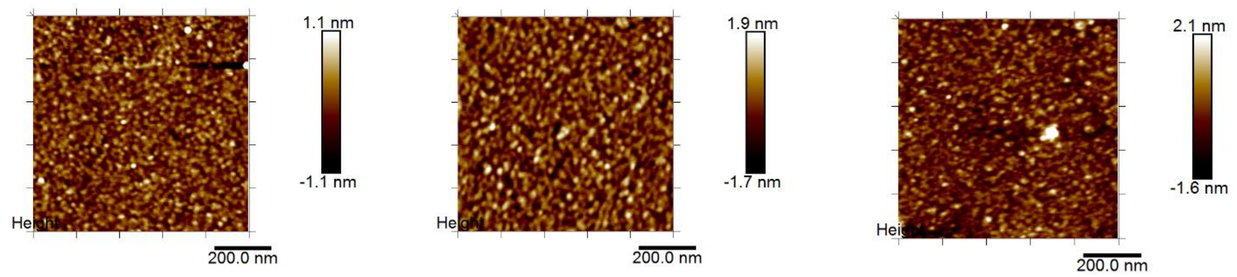
Procedure

- Utilized AFM (atomic force microscope) to analyze surface (Rq) of existing thin film samples
- Created solutions to mimic tear fluid and test for short term and long term wear:
  - H_2O (Water) + $C_2O_4H_2$ (Oxalic Acid)
  - Lens solution (Kroger Brand) + $C_2O_4H_2$
  - Lens solution
- Samples entered solutions which were heated to body temperature (37° C)
- Short term samples were removed after 17 hours
- Long term samples removed after 48 hours
- n-HPA (functionalized) samples removed after 24 hours
- Control samples for functionalized and non-functionalized were created for comparison
- Analyzed results with AFM



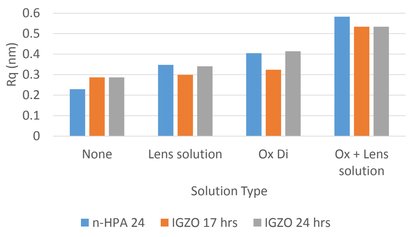
Labeled solutions

Bare IGZO | $C_2O_4H_2$ and Lens Solution, 17 hours | $C_2O_4H_2$ and Lens Solution, 48 hours

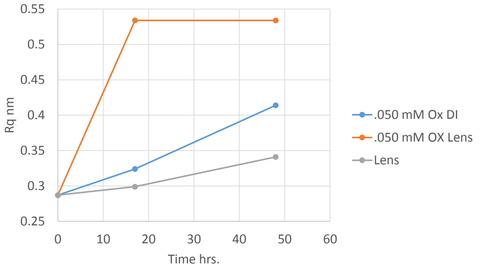


Bare IGZO in $C_2O_4H_2$ + Lens solution T=0 to 48 hours
Rq = 0.287 Rq = 0.534 Rq = 0.534 respectively

Surface Roughness Comparison of n-HPA and IGZO Samples



Surface Roughness (Rq nm) vs. Time (hrs) of IGZO in Various Solutions



Team on July 20, 2017

Conclusion

- $C_2O_4H_2$ + Lens solution showed the largest Rq (surface roughness)
- $C_2O_4H_2$ + H_2O solution exhibited lower Rq
- Lens solution had the least aggressive result
- n-HPA samples showed similar Rq values to the IGZO samples suggesting that passivation either did not occur or was ineffective

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