DESIGNING A STRESS/STRAIN APPARATUS FOR ORGANIC FIELD-EFFECT TRANSISTORS

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So what’s happening in the Kagan Lab?

- What are there applications?
- What advantages do they bring?
- How is my project involved?

Field-Effect Transistors (FETs)
How to bend a FET?

- Use an instron to induce the bend
- Use a mandrel to induce the bend
- Bend the device across something with a fixed diameter (i.e. cylinder)
Four-Point Bending

- Four points of contact with the substrate
- Bending moment varies with position
- Constant bending moment within “b”
- Constant radius of curvature
Four-Point Bending as a quantitative analysis

Bending Moment

Regions a
\[ EI \frac{d^2y}{dx^2} = M(x) = \frac{F}{2} x \]

Center
\[ EI \frac{d^2y}{dx^2} = M(x) = \frac{F}{2} a \]

Deflection

Regions a
\[ y(x) = \frac{1}{EI} \left[ Fx^3 \frac{1}{12} + Fa \left( a \frac{a}{4} - \frac{(L/2)}{2} \right) x \right] \]

Center
\[ y(x) = \frac{1}{EI} \left[ Fa \frac{a^2}{4x^2} + Fa^3 \frac{1}{12} - Fa(L/2) \frac{1}{2} \right] x \]

E = Young’s Modulus
I = Moment of Inertia
Four-Point Bending as a quantitative analysis cont.

**Center/Region b**

- **Strain**
  \[ \varepsilon = \frac{\sigma}{E} \]

- **Radius of Curvature/Bending Moment Relation**
  \[ \frac{1}{\rho} = \frac{M(x)}{EI} \]

- **Stress**
  \[ \sigma = \frac{M(x)c}{I} \]
So where are we now?

Designing Custom Parts
Applying the downward force on the apparatus using a precision mechanical stage setup
We hope to have a four-point bend apparatus that will resemble the conceptualized designs above.
Future Work

- Testing the effectiveness of the apparatus
- Bending the transistors and observing any changes in their properties
- Comparing the tested results with the quantitative solutions
- Reconfiguring the transistors to perform better if needed
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