Class 20: Memories-EEPROMs and FLASH II

Topics:
1. DP Issues
2. EEPROMs and Flash Basics
3. Cell Vt shift
4. Window Closure
5. Band Diagrams
6. Band Diagrams
7. Oxide Conduction
8. FN Conduction
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EEPROM and Flash Basics

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<tr>
<td>programming</td>
<td>FN-byte</td>
<td>HCI/FN-bit</td>
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<tr>
<td>erase</td>
<td>FN-byte</td>
<td>FN-sector</td>
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<td>pass xtor</td>
<td>yes</td>
<td>no</td>
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Programming
- FN - low current, high potentials
- HCI - high current, lower potentials

Erase
- FN - inherent failure mechanism

Read
- Sense current
- Sense voltage
- Either method needs good dummy cell for comparison
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Cell Vt Shift

- UV State - initial state of bits, read ~100uA at 5V
- PGM State - charge on floating gate, read ~0uA at 5V
- EE State - all charge off floating gate
  - should be same as UV state, not always the case
What is a window?
What is cause of window closure?
Programming
• high positive potential on CG
• electrons tunnel drain->FG

Static
• electrons trapped on FG
• surface bands remain bent

Erase
• high positive potential on source or
• high negative potential on CG
• electrons tunnel FG->source
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Band Diagrams (Elias)

Erase
• high positive potential on source
• electrons tunnel FG->source
Various types conduction mechanisms through oxides
Variation with temperature allows differentiation
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FN Conduction (Elias)

FN as a function of temperature, area