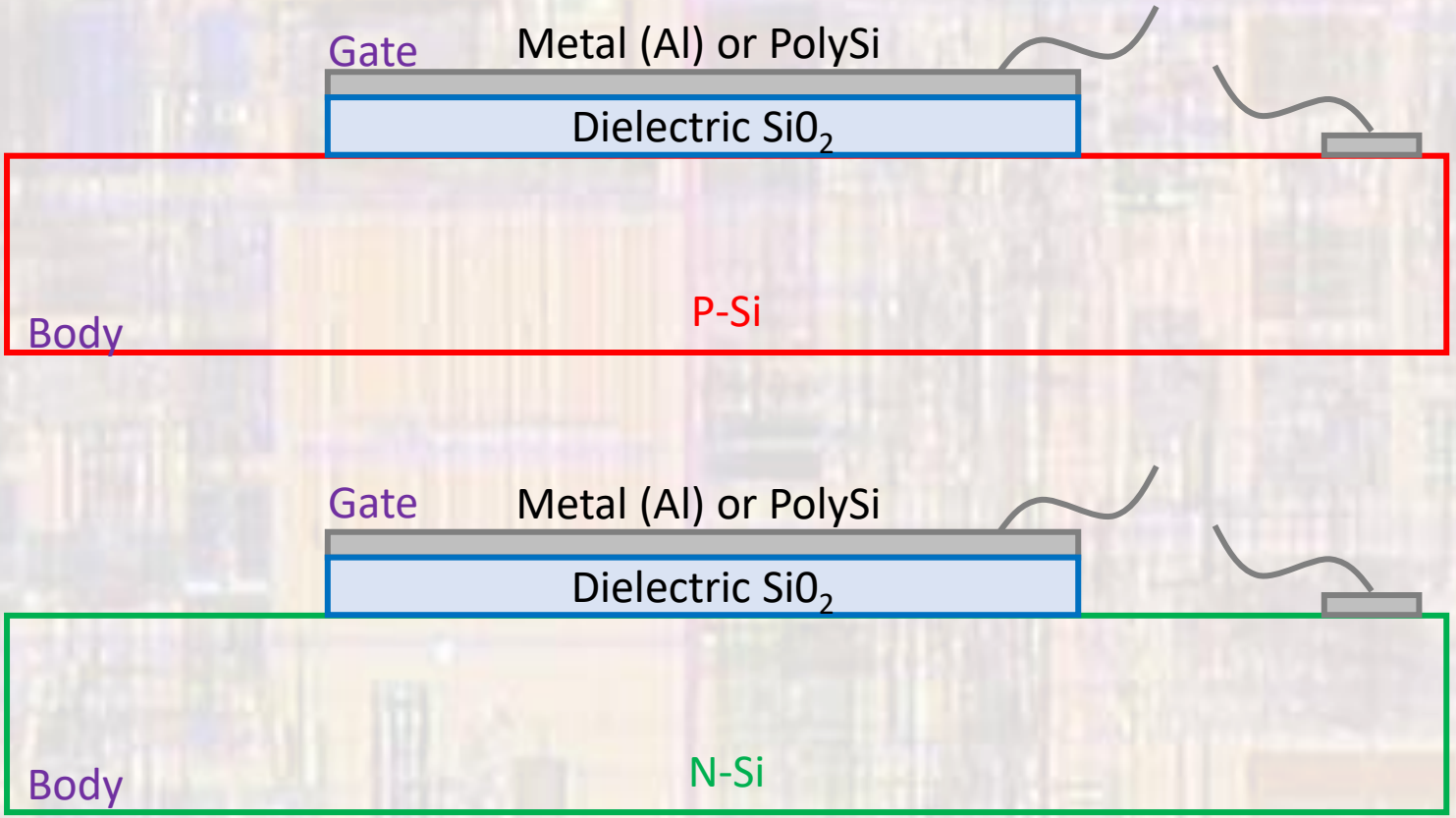
Metal Oxide Semiconductor Capacitor

Last updated 3/24/22

MOS Capacitor

- Structure



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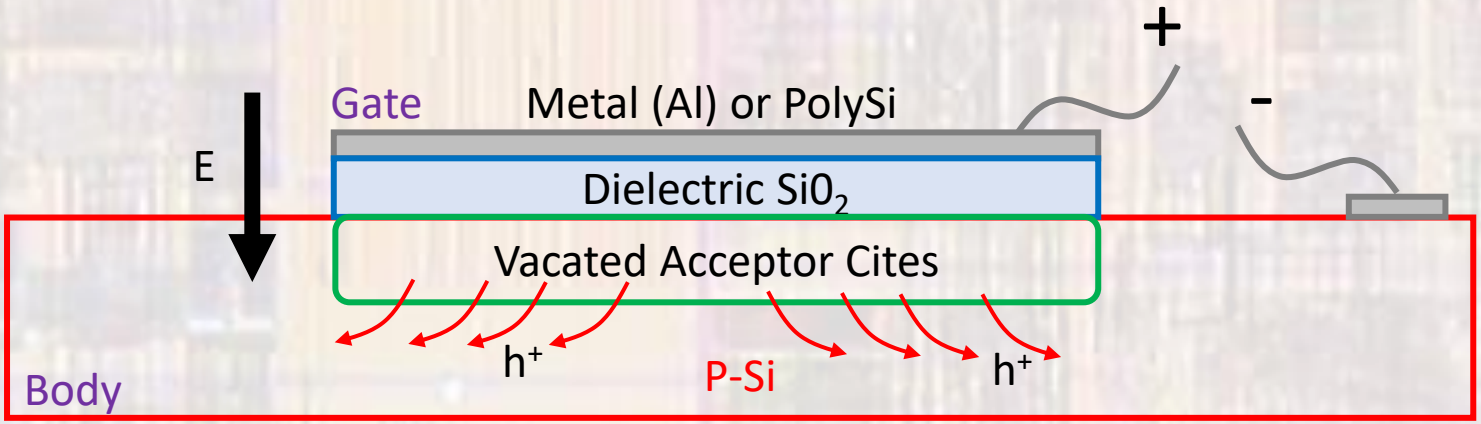
MOS Capacitor

- Operation
  - Positive Bias (P-Si)
    - Depletion region is formed
      - Mobile holes pushed away (region is depleted of holes)
      - Net negative (fixed) charge left behind



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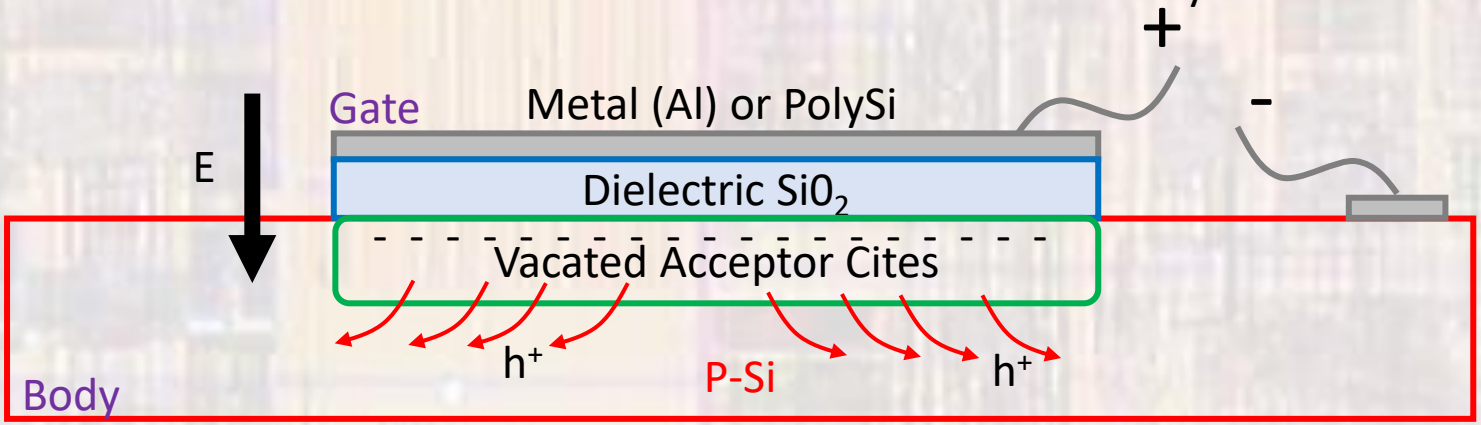
MOS Capacitor

- Operation
  - Large Positive Bias (P-Si)
    - Depletion region is formed
      - Mobile holes pushed away (region is depleted of holes)
      - Net negative (fixed) charge left behind
      - Electrons are drawn from the Si to form an inversion layer



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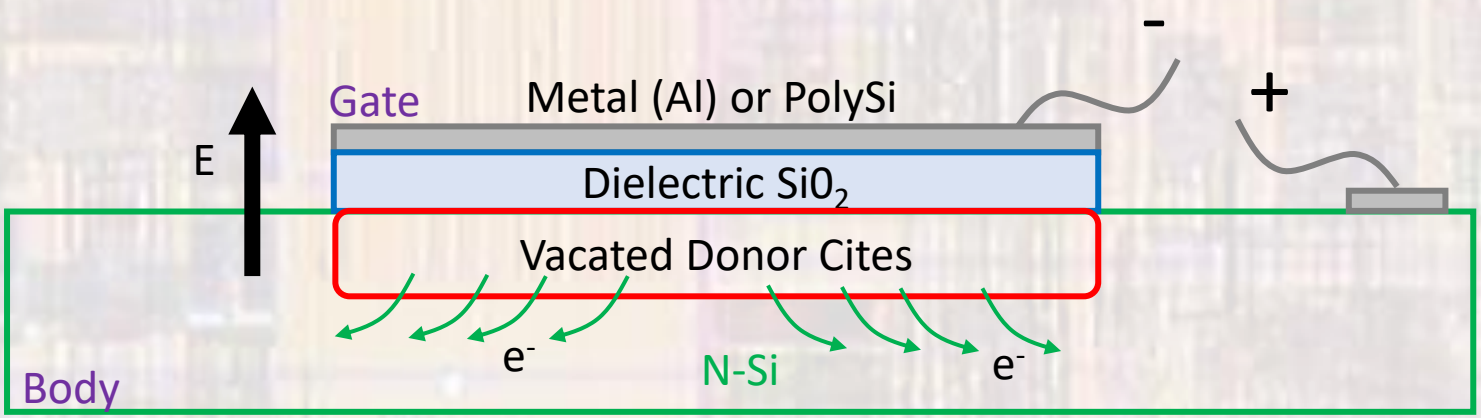
MOS Capacitor

- Operation
  - Negative Bias (N-Si)
    - Depletion region is formed
      - Mobile electrons pushed away (region is depleted of electrons)
      - Net positive (fixed) charge left behind



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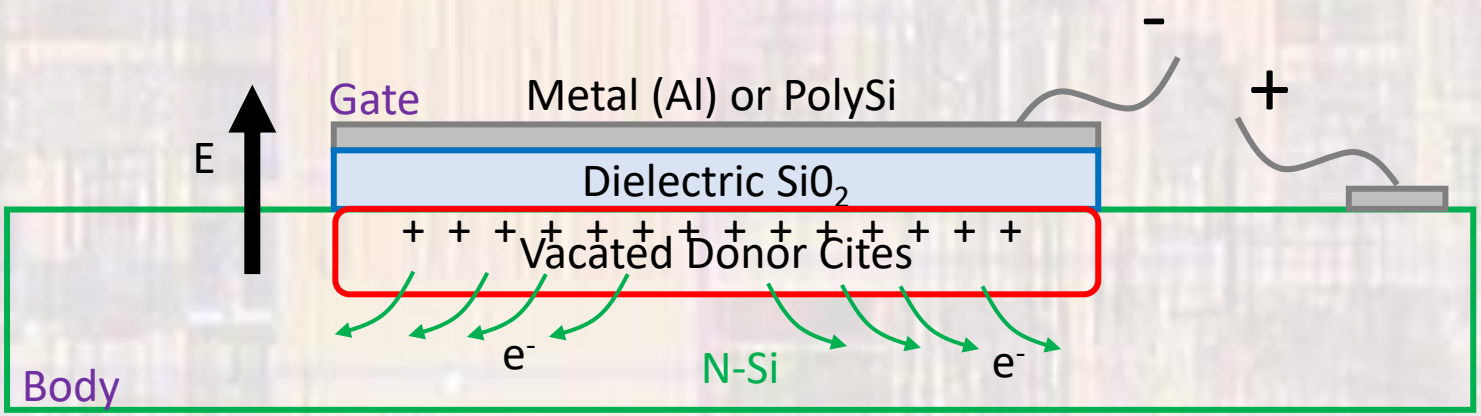

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MOS Capacitor

- Parameters
  - A – cross section area of the capacitor
    - $1x10^{-15}$ m^2
  - t_{ox} – thickness of the oxide
    - 15-20 Angstroms – 3 to 4 atom layers
    - $1.5 – 2.0x10^{-9}$ m
  - ε_0 – permittivity (dielectric constant) of free space
    - $8.85x10^{-12}$F/m
  - $\varepsilon_r(SiO_2)$ – relative permittivity multiplier for SiO_2
    - 3.9

$$C_{ox} = {\varepsilon_{ox}}/{t_{ox}} = {\varepsilon_0 \varepsilon_r}/{t_{ox}}$$

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