The measurements of doping density in InAs by capacitance-voltage techniques with electrolyte barriers

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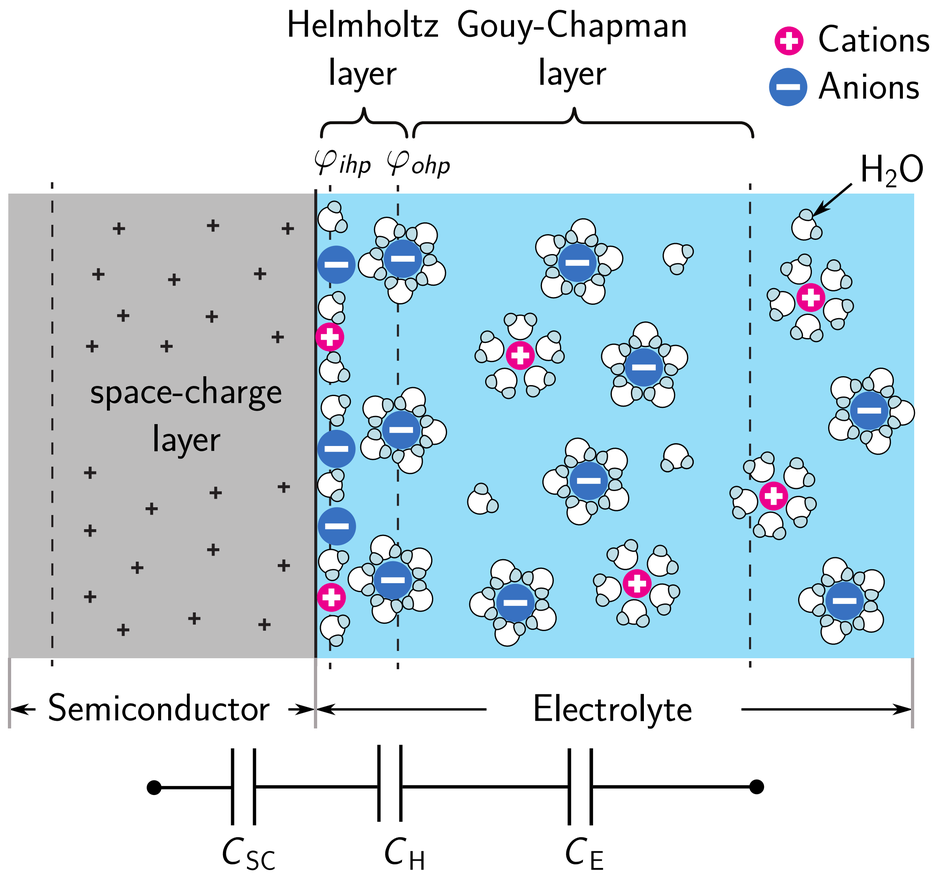
Motivation

- Schottky contact is usually used in capacitance-voltage characterisation
- Formation of reliable Schottky contact in InAs is difficult due to surface accumulation
- Electrolyte can be used to form Schottky-like barrier
- Using depletion approximation for electrolyte based capacitance-voltage results gives higher concentration compering to Hall measurements

Semiconductor-electrolyte interface



The structure of semiconductor-electrolyte interface

Simulation

Capacitance-voltage characteristics were calculated form potential detributions obtained by solving Poisson equation with modified Thomas-Fermi approximation (MTFA).

Poisson equation

$$\frac{d^2\varphi}{dz^2} = -\frac{q}{\varepsilon\varepsilon_0}\left[N_D^+ - N_A^- - n(z) + p(z)\right]$$

$$n(z) = \int_0^\infty \rho_c(z,E) f_{FD}(E) f_{MTFA}(z,E) dE$$

$$\rho(z,E) = \frac{1}{2\pi^2}\left(\frac{2m_\Gamma}{\hbar^2}\right)^{3/2} \sqrt{E}\cdot\sqrt{1+\alpha E)}\cdot(1+2\alpha E)$$

where $\alpha = \frac{1}{E_g}\left(1-\frac{m_\Gamma}{m_0}\right)^2$ — nonparabolicity coefficient

Modified Thomas-Fermi approximation

MTFA used to take into account surface accumulation.

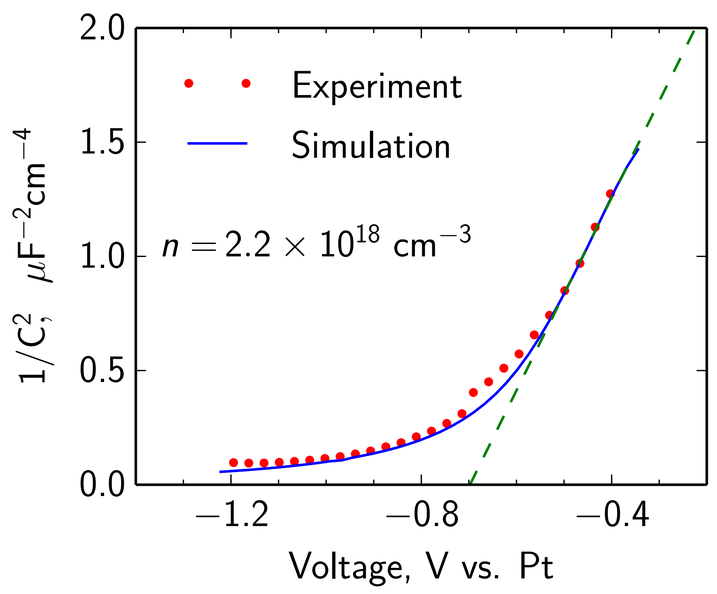
$$f_{MTFA}(z,E) = 1 - sinc\left(\frac{2z}{L}\left(\frac{E}{k_B T}\right)^{1/2}(1+\alpha E)^{1/2}\right)$$

Results

Potential distribution

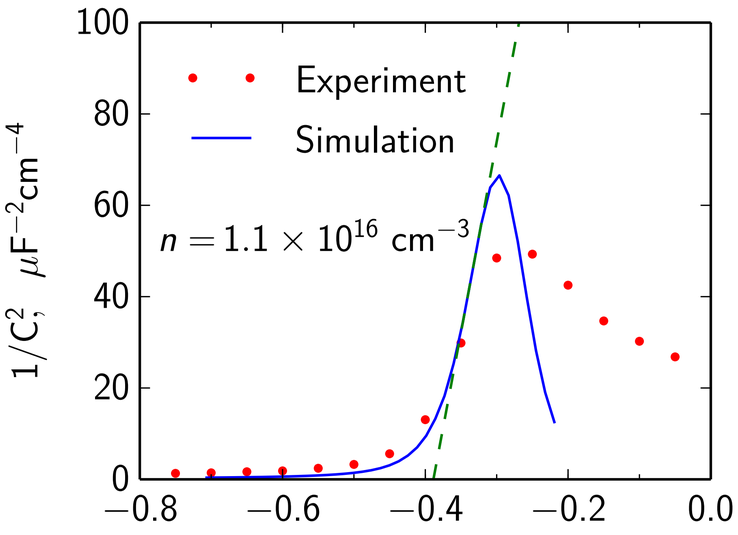
- The first item
- The second item
- The third etc ...

Mott-Schottky plots of InAs-electrolyte



Mott-Schotky plot of n^+-InAs

- The first item
- The second item
- The third etc ...



Mott-Schotky plot of epi-InAs

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Summary

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