Modelling the interaction between LTPs and separation membranes

Projeto Integrador de 2º Ciclo – Projeto Científico
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Modelling plasma-membrane systems

- Fluid Model Approach: Equations governing macroscopic properties and electric field.
- Different models can be adopted:

$$\frac{\partial n_s}{\partial t} + \frac{\partial (n_s u_s)}{\partial x} = S_s,$$

$$\frac{\partial (n_s u_s)}{\partial t} + \frac{\partial}{\partial x}\left(n_s u_s^2 + \frac{p_s}{m_s}\right) = \frac{q_s}{m_s} n_s E + C_s,$$

$$\frac{\partial (n_s \varepsilon_s)}{\partial t} + \frac{\partial}{\partial x}\left[\left(n_s \varepsilon_s + p_s\right) u_s\right] = q_s n_s u_s E + R_s.$$

Full Fluid Moment (FFM) model

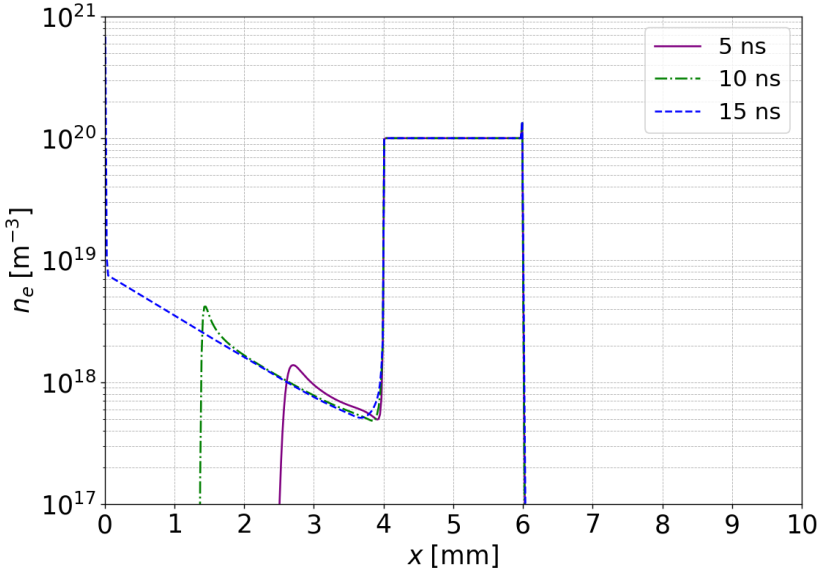
$$\frac{\partial n_s}{\partial t} + \frac{\partial \Gamma_s}{\partial x} = S_s, \qquad \Gamma_s = \frac{q_s}{|q_s|} \mu_s n_s E - D_s \frac{\partial n_s}{\partial x}$$

$$\frac{\partial n_{\varepsilon_s}}{\partial t} + \frac{\partial Q_s}{\partial x} = q_s E_x \Gamma_s + R_s, \qquad Q_s = \frac{q_s}{|q_s|} \tilde{\mu}_s n_{\varepsilon_s} E - \tilde{D}_s \frac{\partial n_{\varepsilon_s}}{\partial x}$$

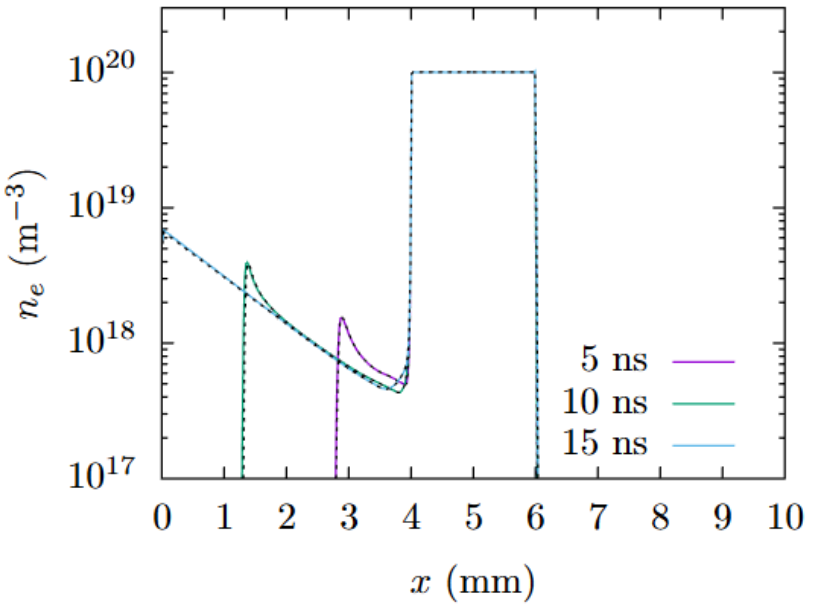
Drift-Diffusion (DD) model

Model Benchmarking – DD

- Benchmark for Drift-Diffusion model also performed – Electron density.



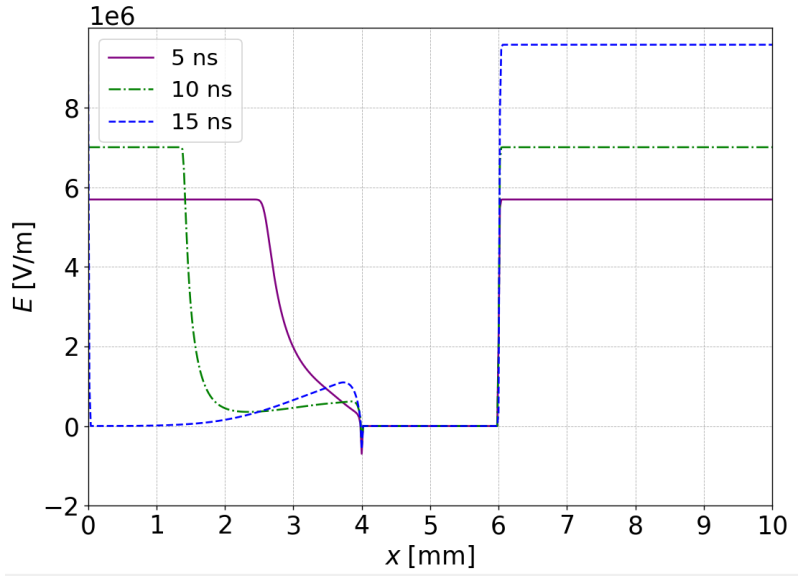
Results from our model



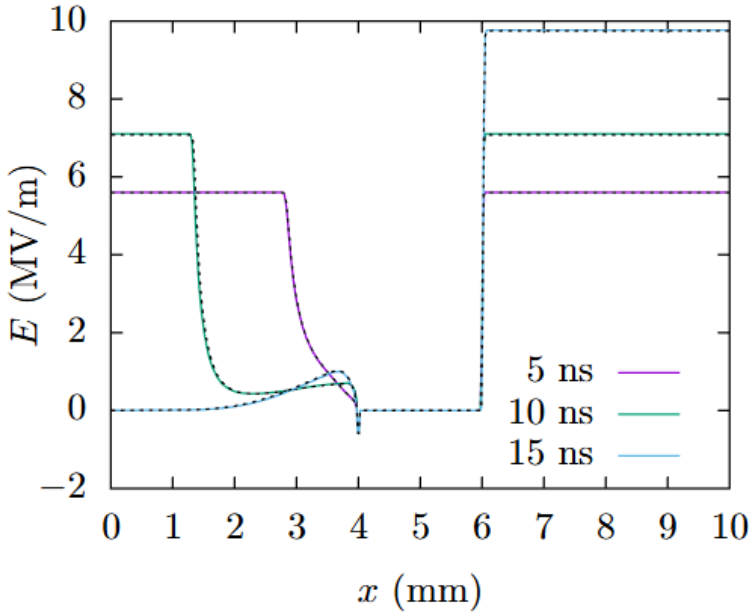
J Teunissen et al. “Improvements for drift-diffusion plasma fluid models with explicit time integration”. In: Plasma Sources Science and Technology 29.1 (2020), p. 015010.

Model Benchmarking – DD

- Benchmark for Drift-Diffusion model also performed – Electric field.



Results from our model



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Next steps

1. Develop a numerical plasma fluid model able to describe the plasma-membrane system;
2. Compare with experimental results:

   Validate the code;

   Conclude on what the best models to describe plasma-membrane systems are;
3. Analyze the mutual effects between plasma and membrane;
4. Determine the best conditions that enhance CO_2 conversion rate and transport through the membrane.

Thank you!

Any Questions?