2D Hydrogen Fuel Cell Dry Model

Channel Optimal Shape Design

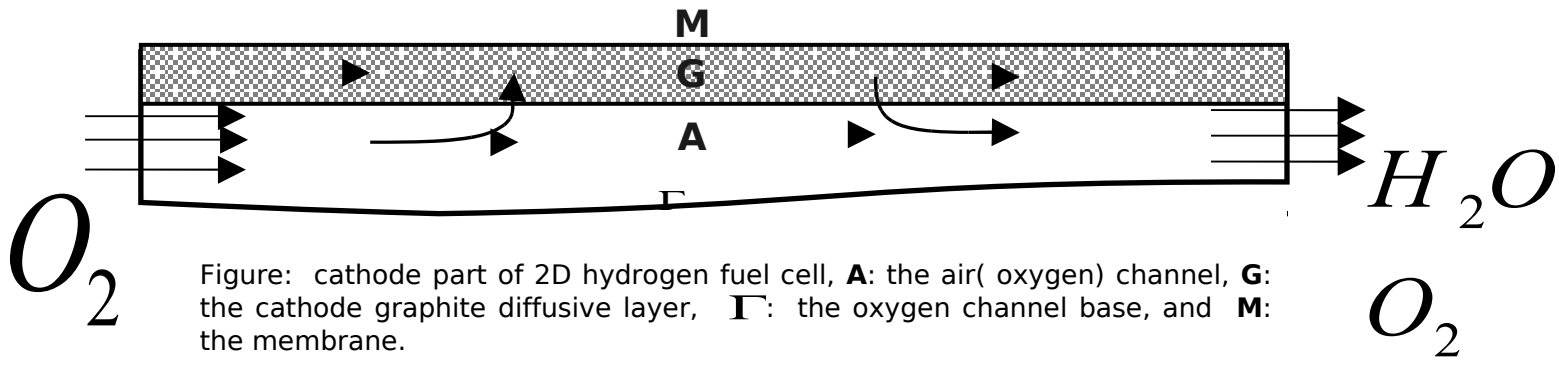


Figure: cathode part of 2D hydrogen fuel cell, **A**: the air(oxygen) channel, **G**: the cathode graphite diffusive layer, Γ: the oxygen channel base, and **M**: the membrane.

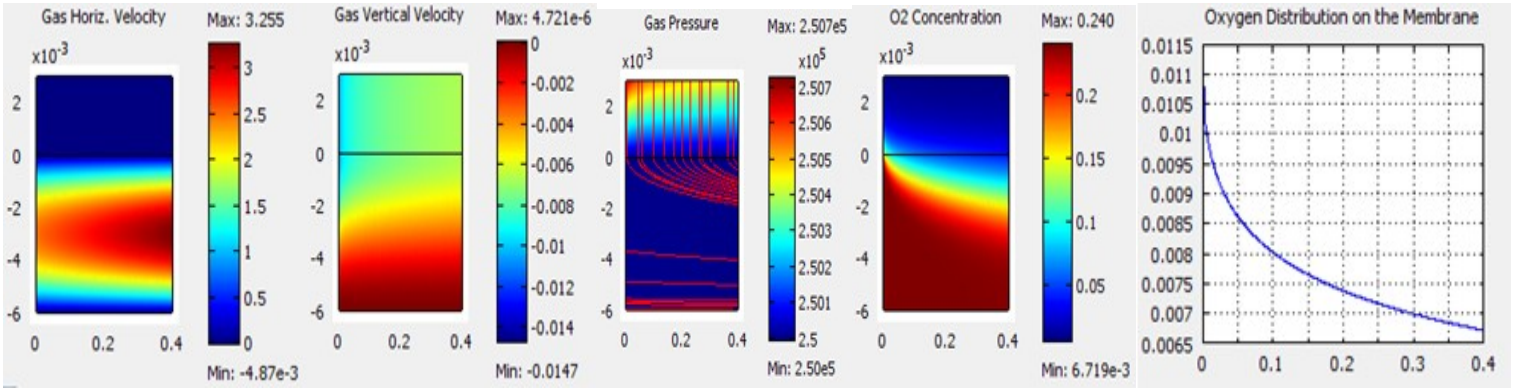
Objective: To design Γ such that the energy function, E, is minimized

$$E(\Gamma) = a\int_M \left(\hat{c} - \int_M \hat{c}\right)^2 - b\int_M \hat{c}$$

Total oxygen variation on M — **The total oxygen on M**

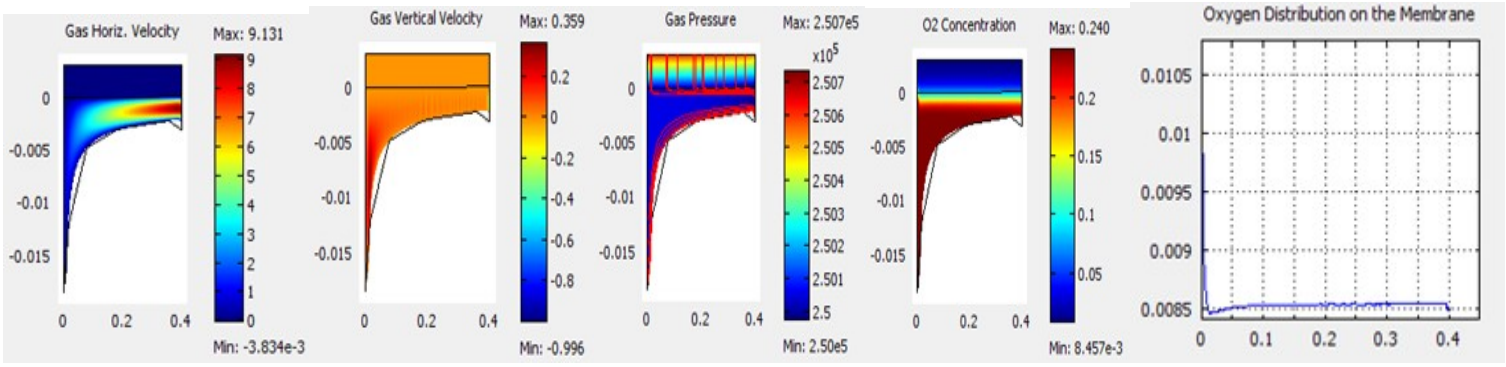
Here, $\hat{c}$ denotes the oxygen concentration, and **a, b** are some nonnegative parameters.

Initial Solution, where Γ is flat:



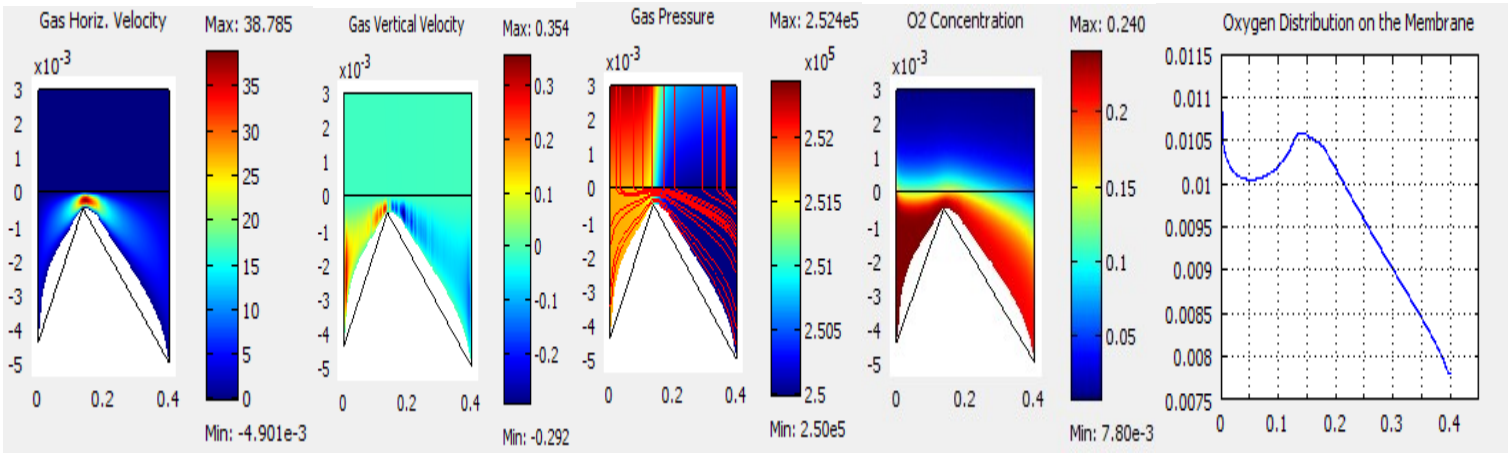
Objective I: How to design Γ such that only the total oxygen variation is minimized on the membrane, M.? That is **a=1, b=0.**

Solution:



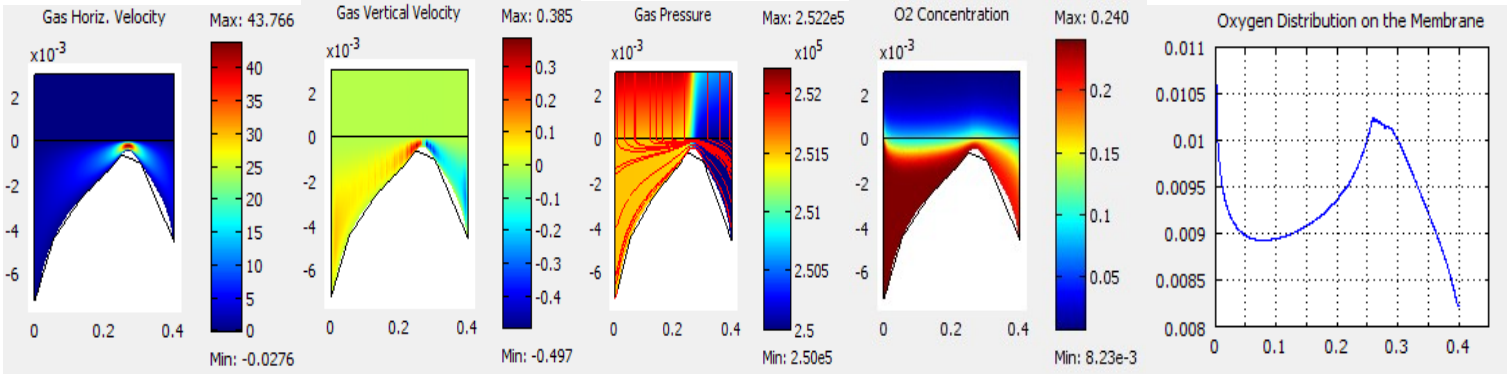
Objective II: How to design Γ such that only the total oxygen is maximized on the membrane, M**?** That is **b=1, a=0.**

Solution:

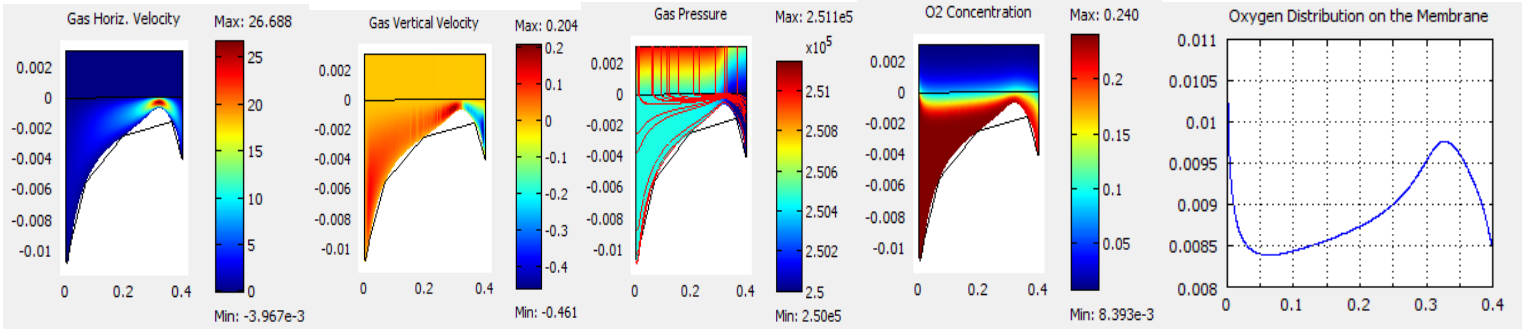


Objective III: To consider both **objective I** and **objective II**, with different values of the parameters **a**, **b** to note the competition between the two objectives.

Case I: a=1e3, b=1. In this case, **objective II** is more important than objective I.



Case II: a=5e3, b=1. Here, both **objective I** and **objective II** have same importance.



Case III: a=5e4, b=1. Here, **objective I** is more important than the second.