

# **Graphene Oxide Embedded Reverse Osmosis Membrane in Both Active and Support Layers**

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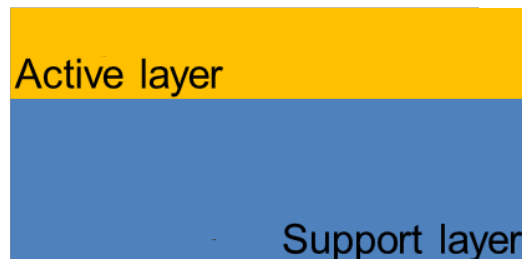
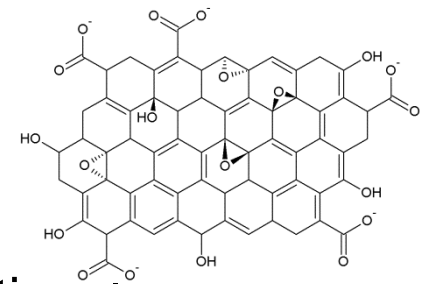
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# Introduction

- The key properties of a RO membrane
  - Water permeability, salt rejection, anti-biofouling, chlorine resistance
- Graphene oxide (GO)
  - : Numerous hydrophilic & negatively charged functional groups
- Thin-film composite (TFC) membrane



# Notation

- Notation of the TFC membranes

→ TFC membrane with GO embedded in **Active** and/or **Support** layers

→  : TFC membrane

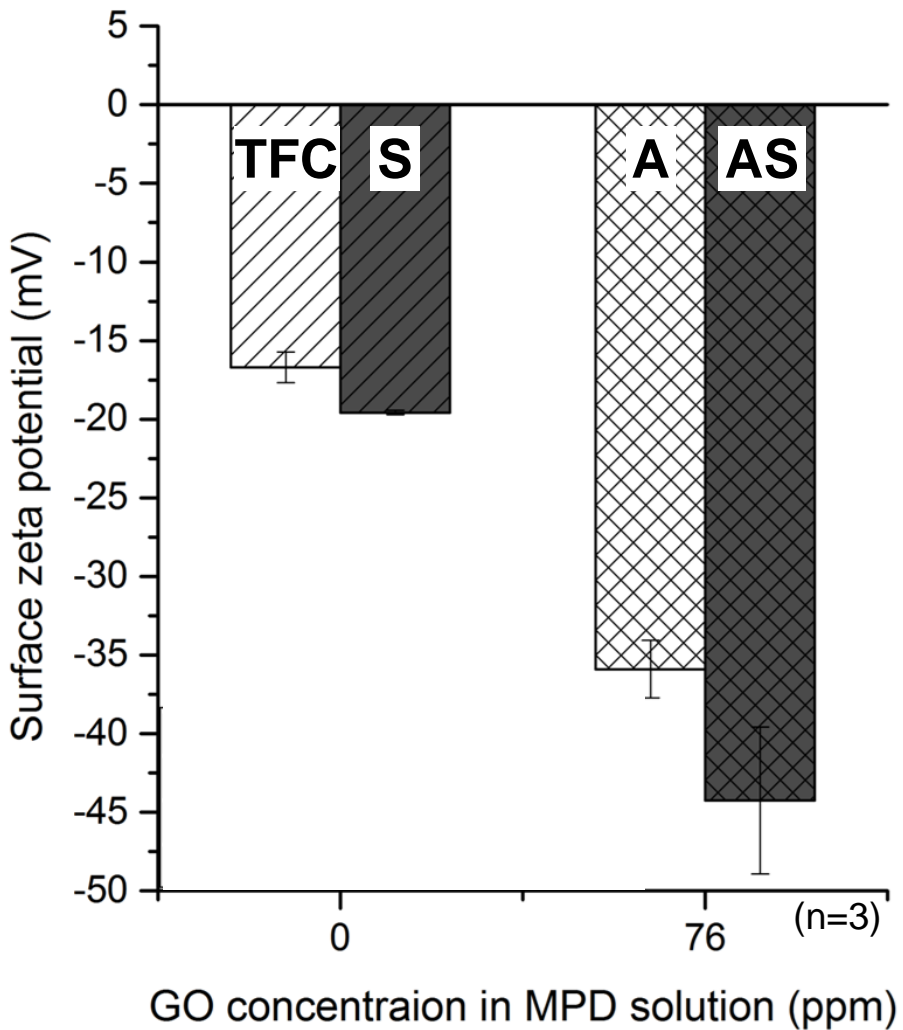
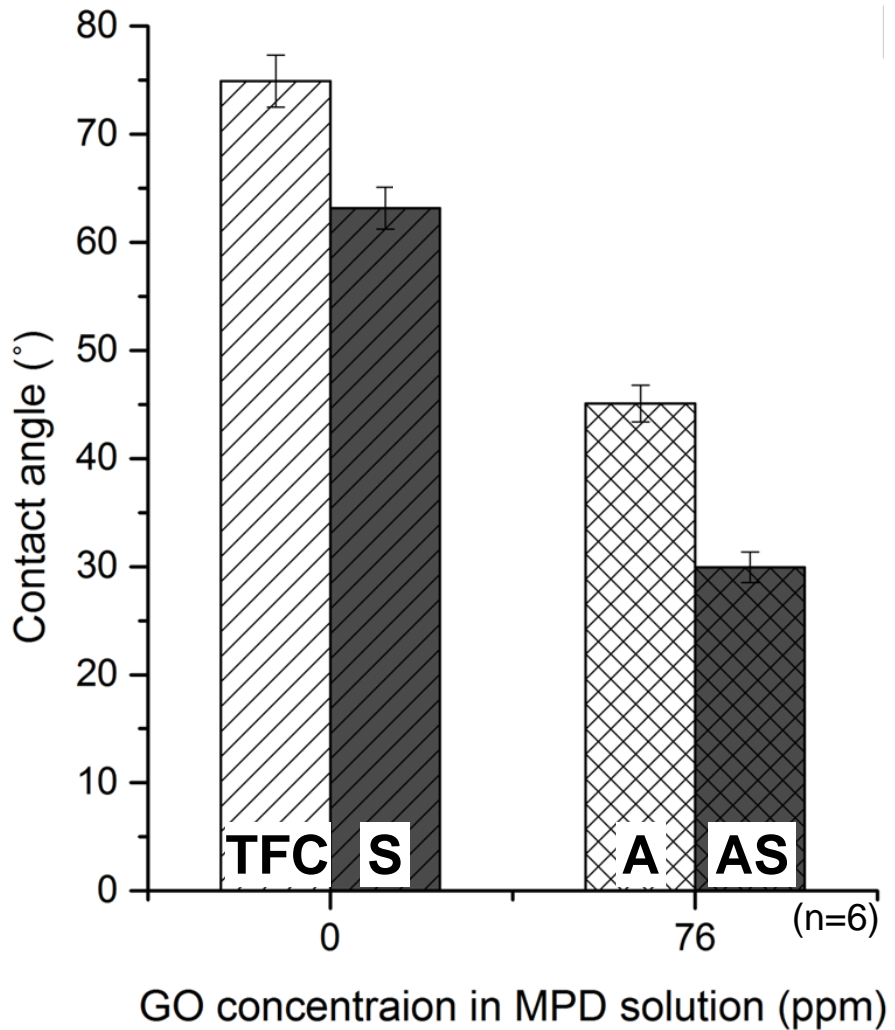
 : **S**-GO-TFC membrane

 : **A**-GO-TFC membrane

 : **AS**-GO-TFC membrane

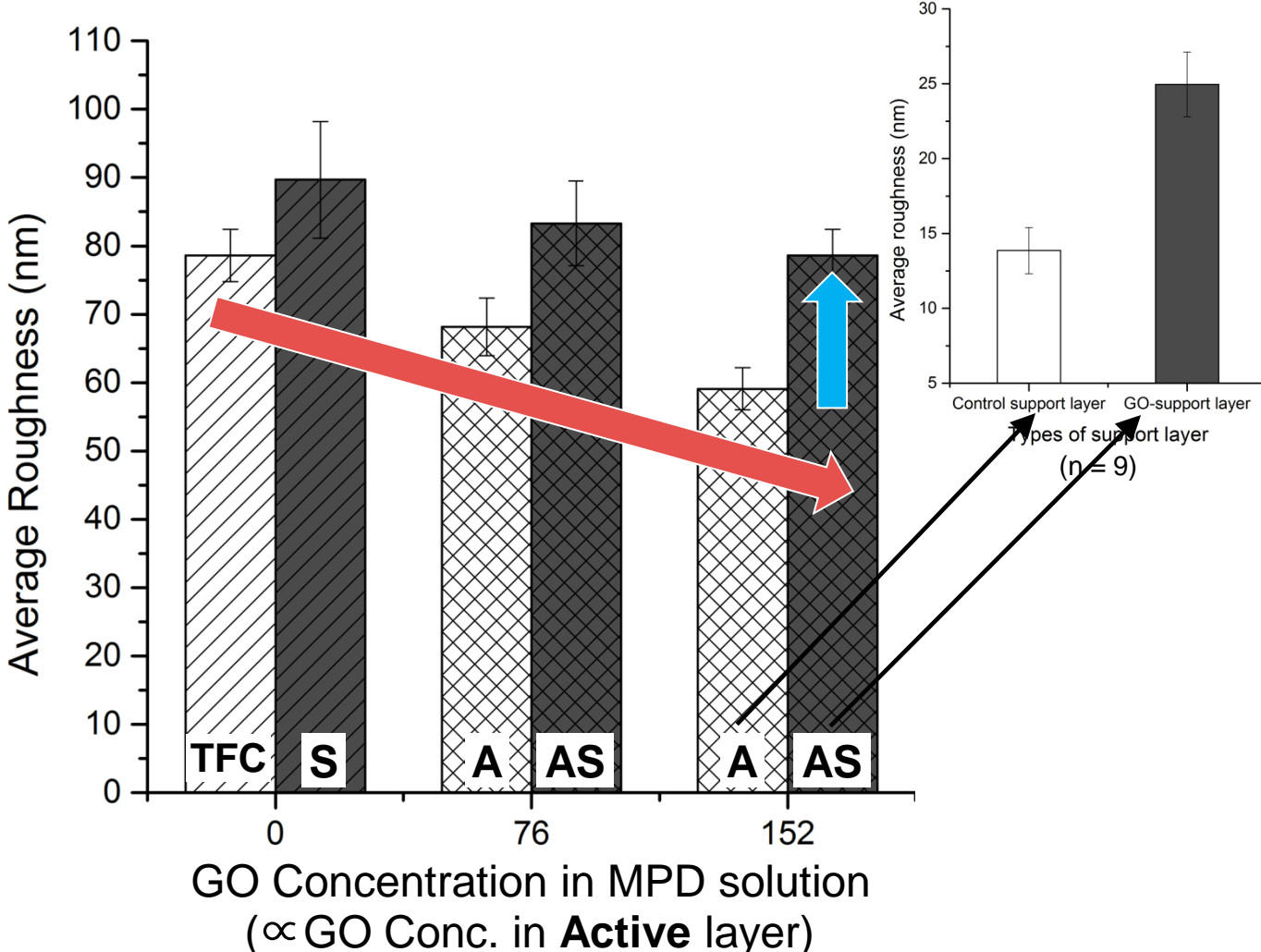
# Characterization of the TFC membranes

- Most hydrophilic & negatively charged AS-GO-TFC membrane  
→ Numerous functional groups of GO



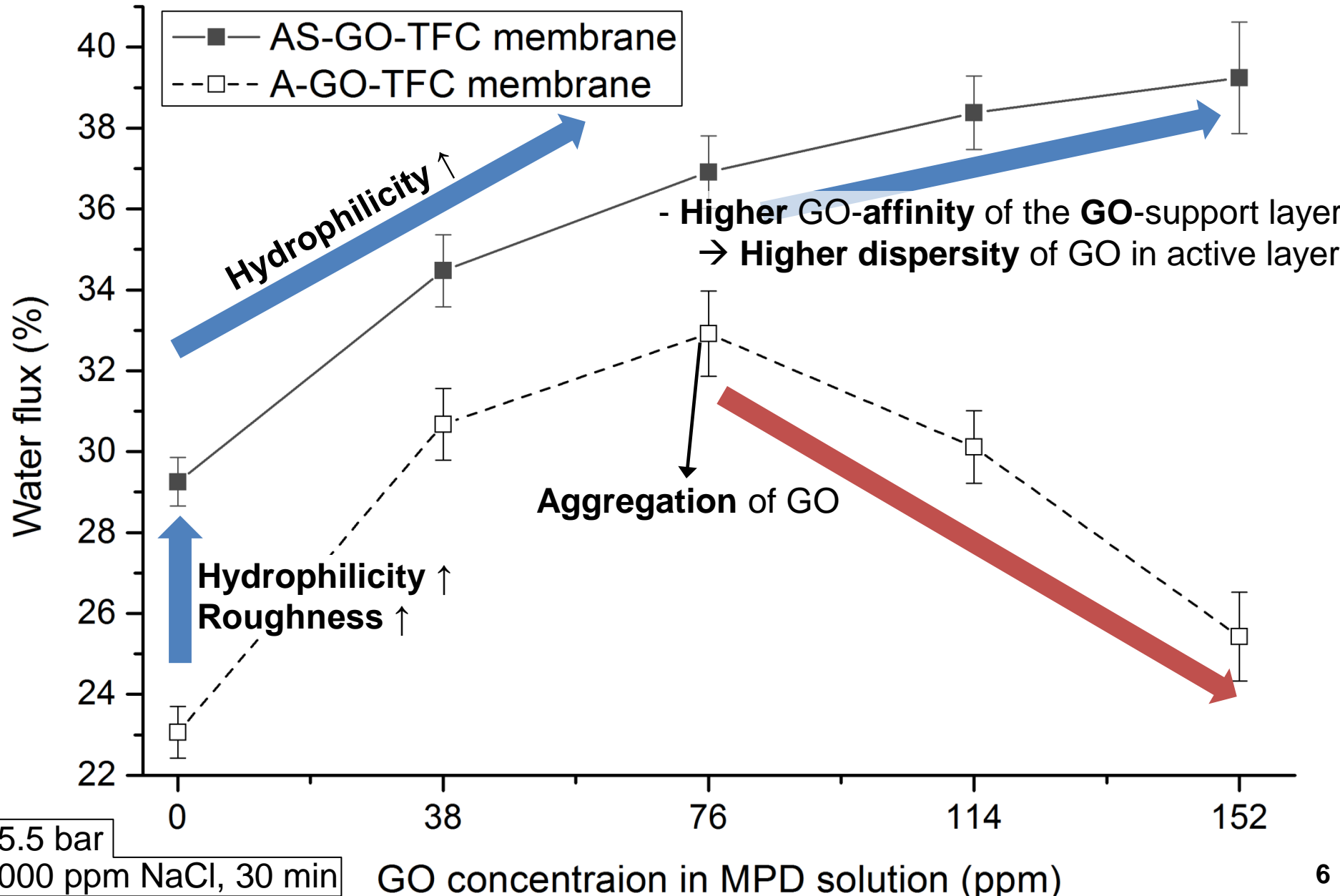
# Surface roughness of the TFC membranes

- Decrease of surface roughness with GO in active layer  
Increase of surface roughness with GO in support layer



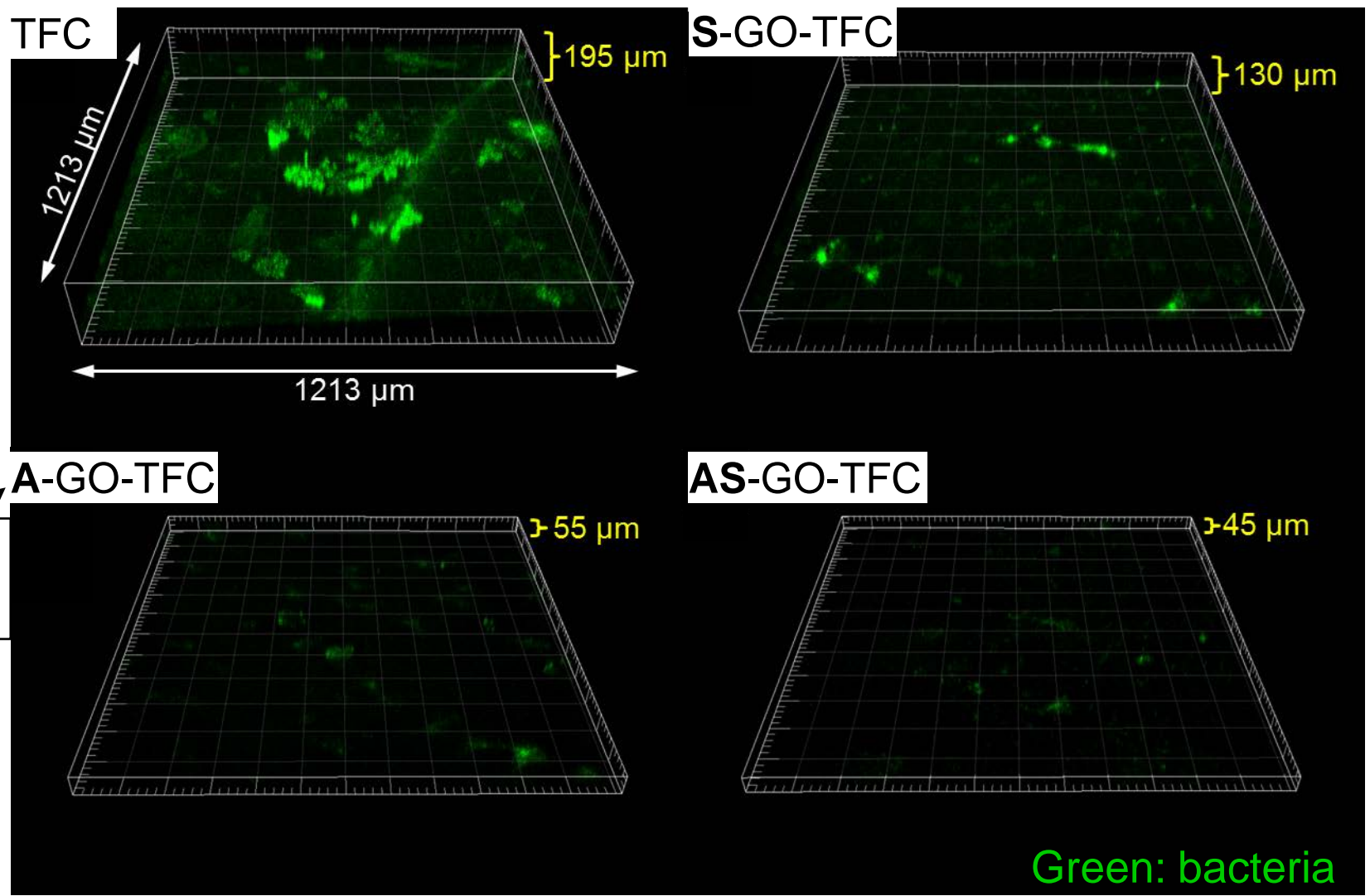
# Water permeability of the TFC membranes

(n = 3)



# Anti-biofouling of the TFC membranes

- CLSM images of the bacteria fouled on membranes

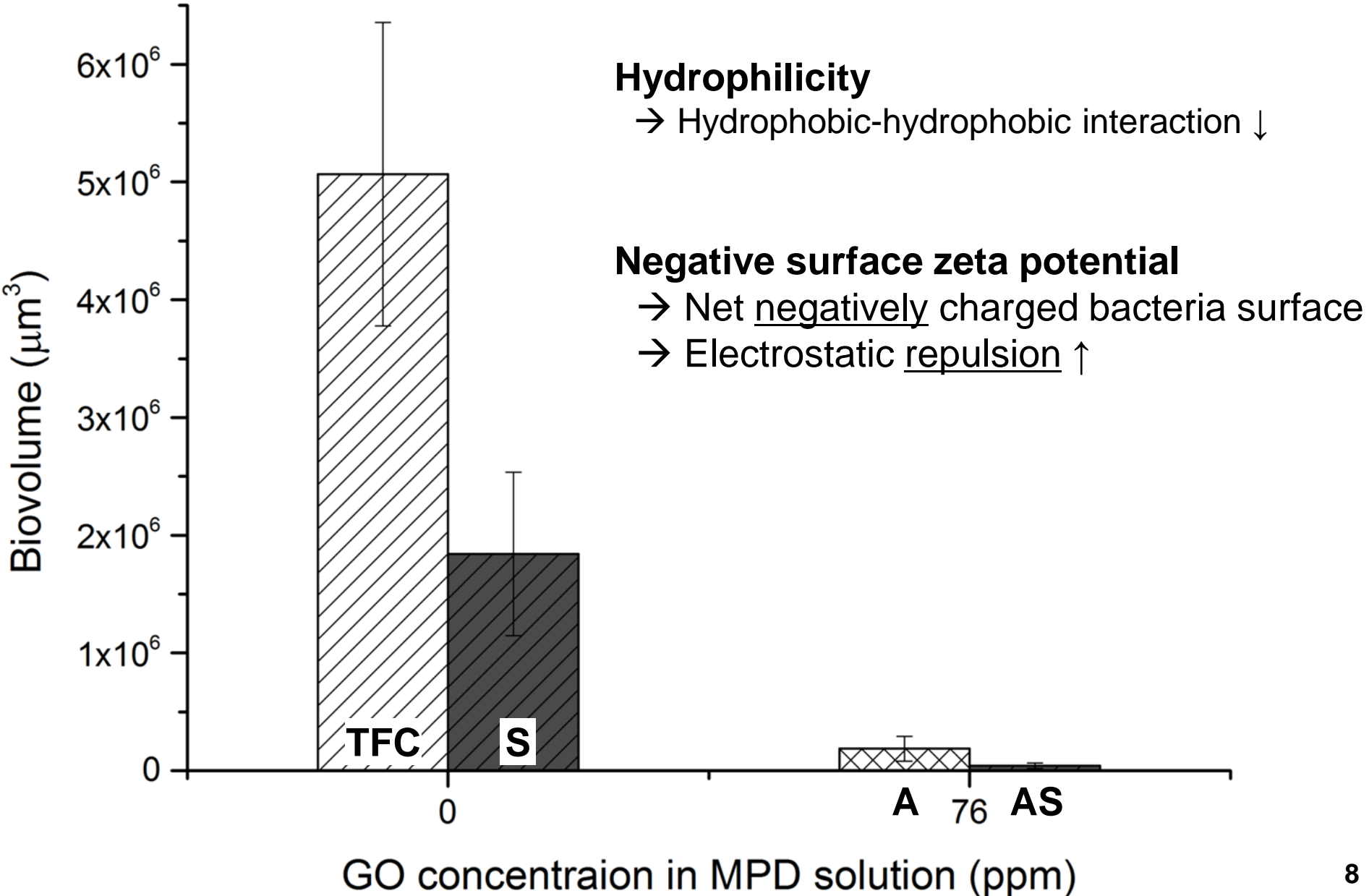


CLSM: confocal laser scanning microscopy

Cell attachment test at 37 °C, 48 h

# Anti-biofouling of the TFC membranes

(n = 9)



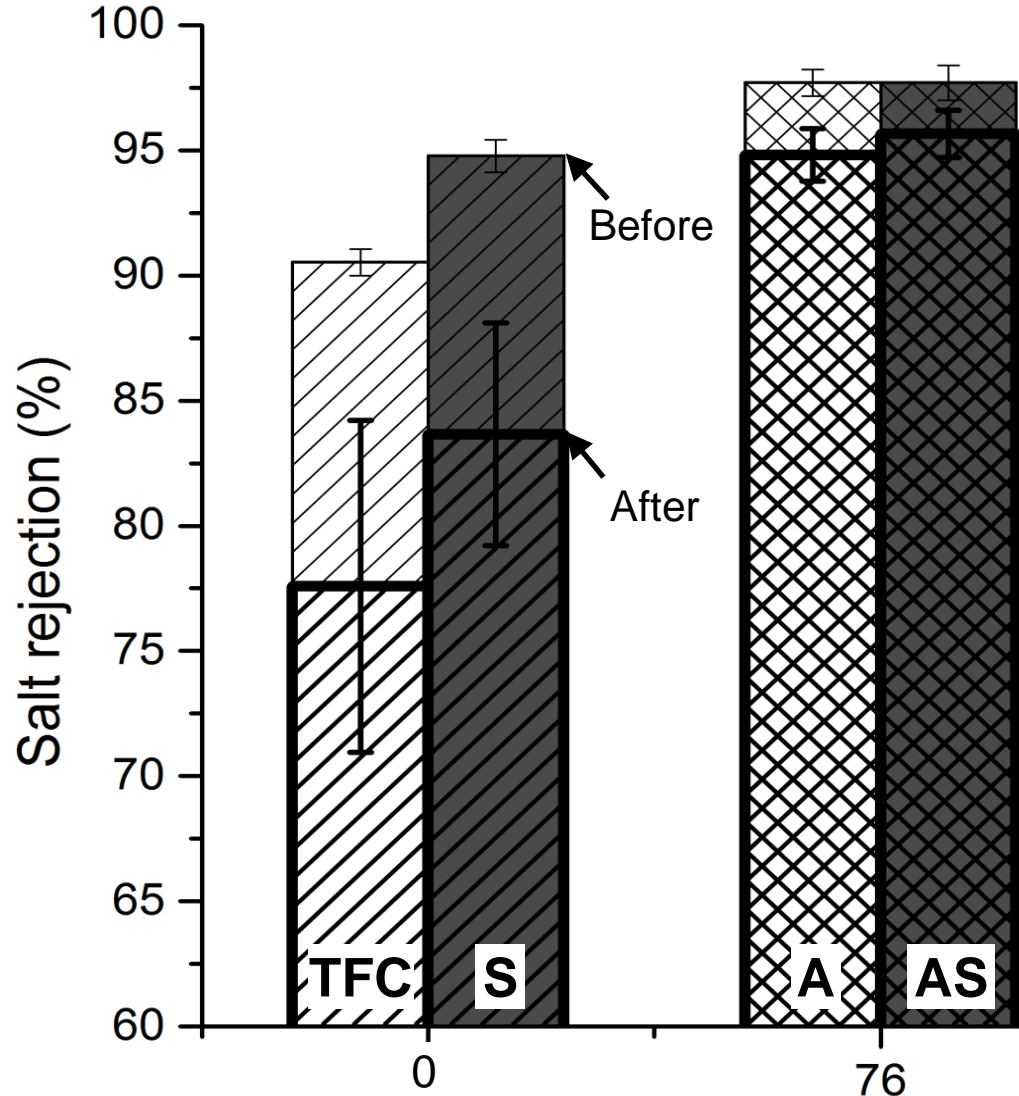


# Chlorine Resistance of the TFC membranes

(n = 3)

5000 ppm NaOCl, 16 h

2000 ppm NaCl, 15.5 bar  
30 min



Only GO in active layer was effective for chlorine resistance

Hydrogen bonding between GO and PA  
→ Impeding replacement of amidic hydrogen with chlorine

GO nanosheets  
→ **Barrier** against chlorine for underlying PA

In active layer

GO concentraion in MPD solution (ppm)

# Acknowledgment

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Thank you  
for your attention!