

# Organic Coatings using Atmospheric Pressure Dielectric Barrier Discharge En Route for a Straightforward Manufacture of Bioactive Films

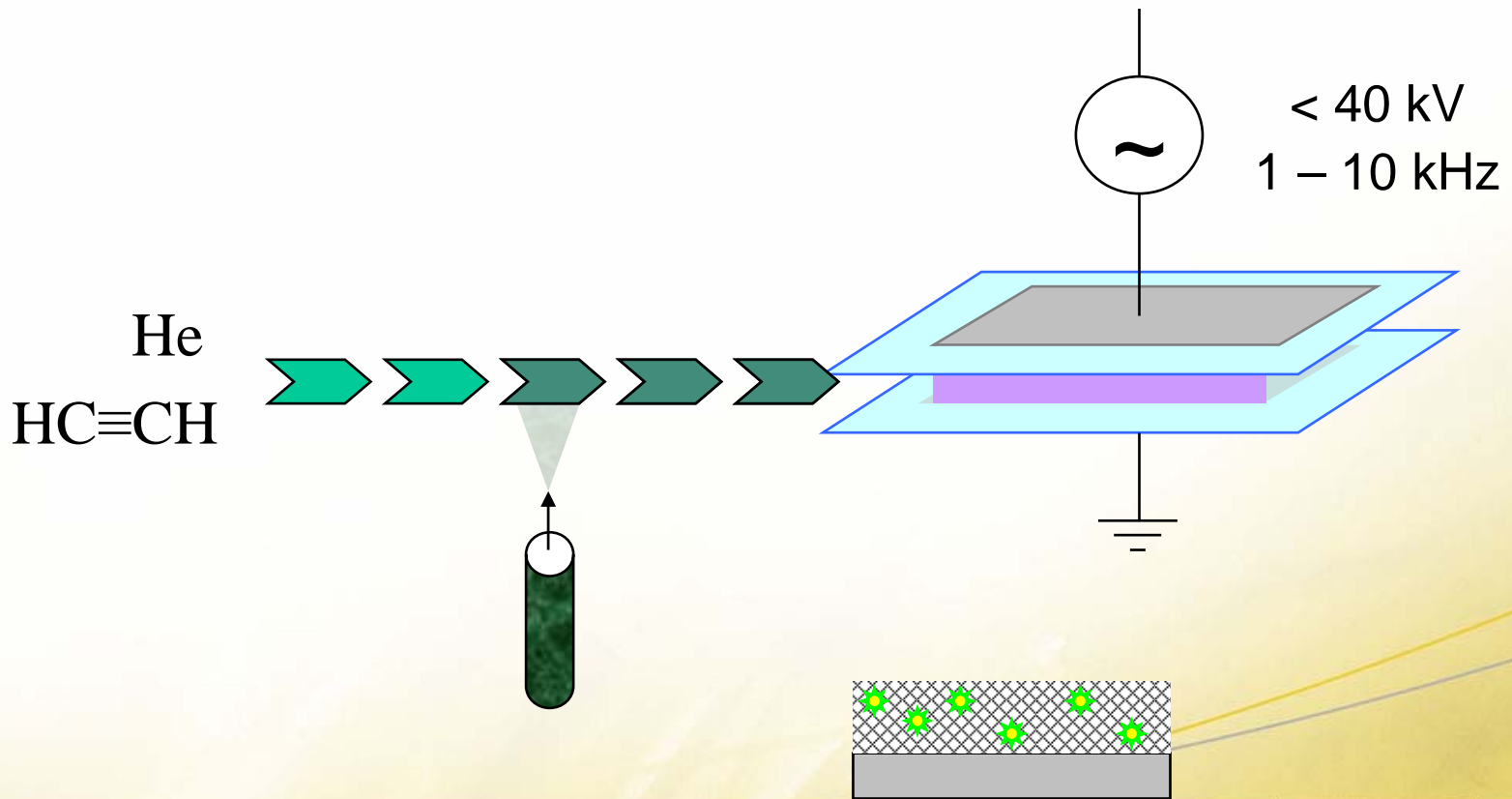
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**P. A. Jacobs, B. F. Sels**



# Plasma's, enzymes and bio-functionality



# Precursor screening

- Sensitive macro-molecules  
-> mild plasma
- Coating  $\nearrow$  if plasma reactivity  $\nearrow$
- Cautious balance between plasma reactivity and growth rate



# Precursor screening

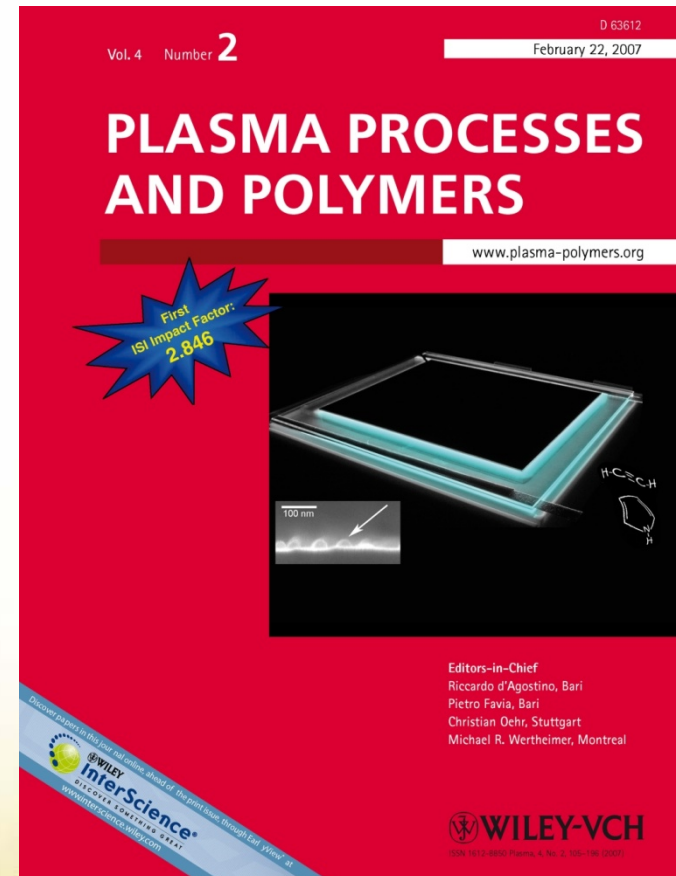
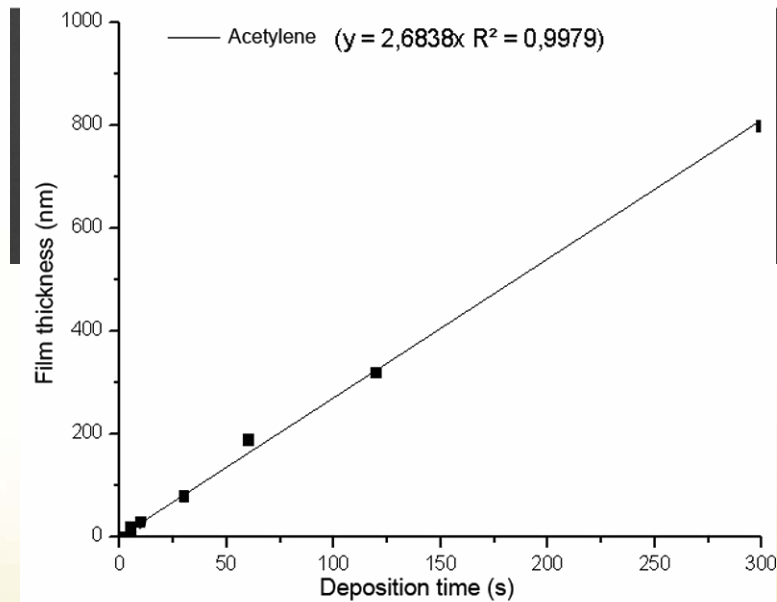
- Over 20 precursors tested
  - acetylene and pyrrole
- Growth rate (acetylene):
  - 2kHz, 0.03 W/cm<sup>2</sup> -> ~16 nm/min
  - 4kHz, 0.3 W/cm<sup>2</sup> -> ~160 nm/min
- Coating and Surface characteristics (IR/NMR/XPS)

Acetylene	Pyrrole
C=C, C≡C	Pyrrole mon., C-N, C≡N
C=O, C-O	O=C-N, C-O

→ ~ tunable surface E



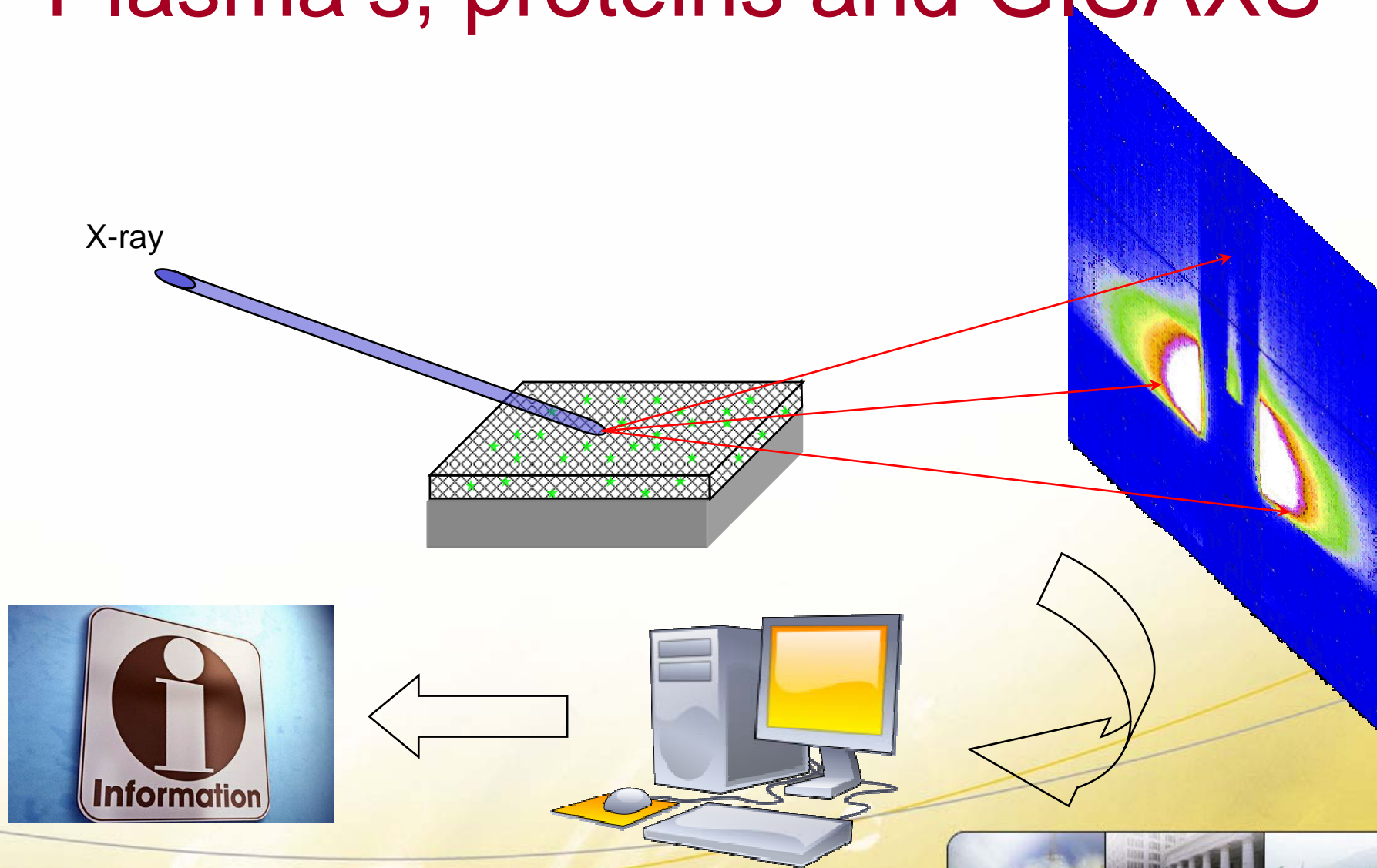
# Precursor screening



Plasma Processes and Polymers, 4(2), 2007, 145-157

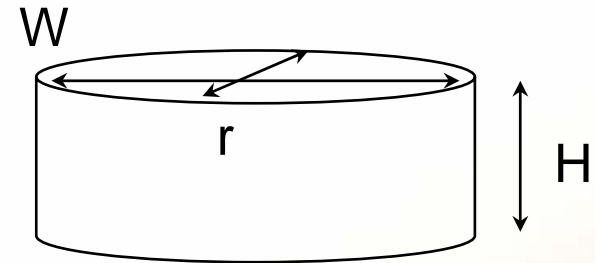
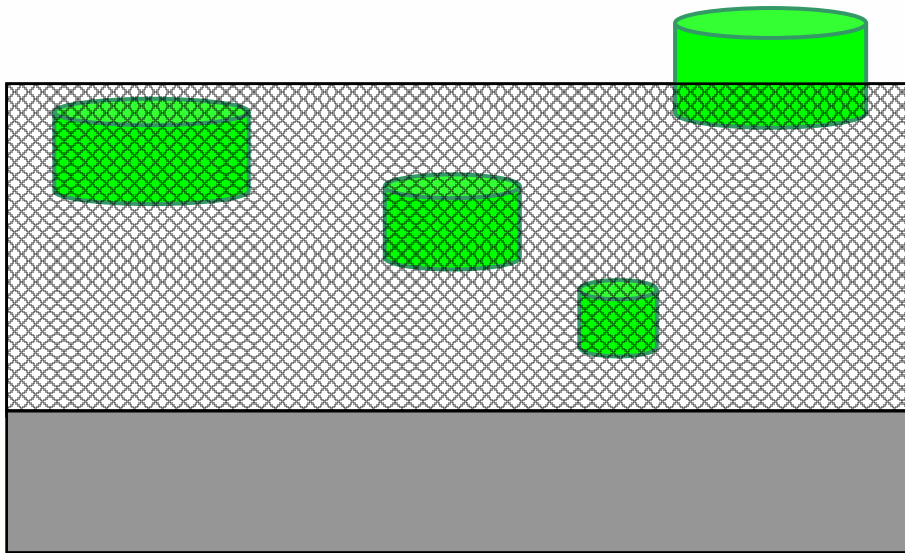


# Plasma's, proteins and GISAXS





# Plasma's, proteins and GISAXS

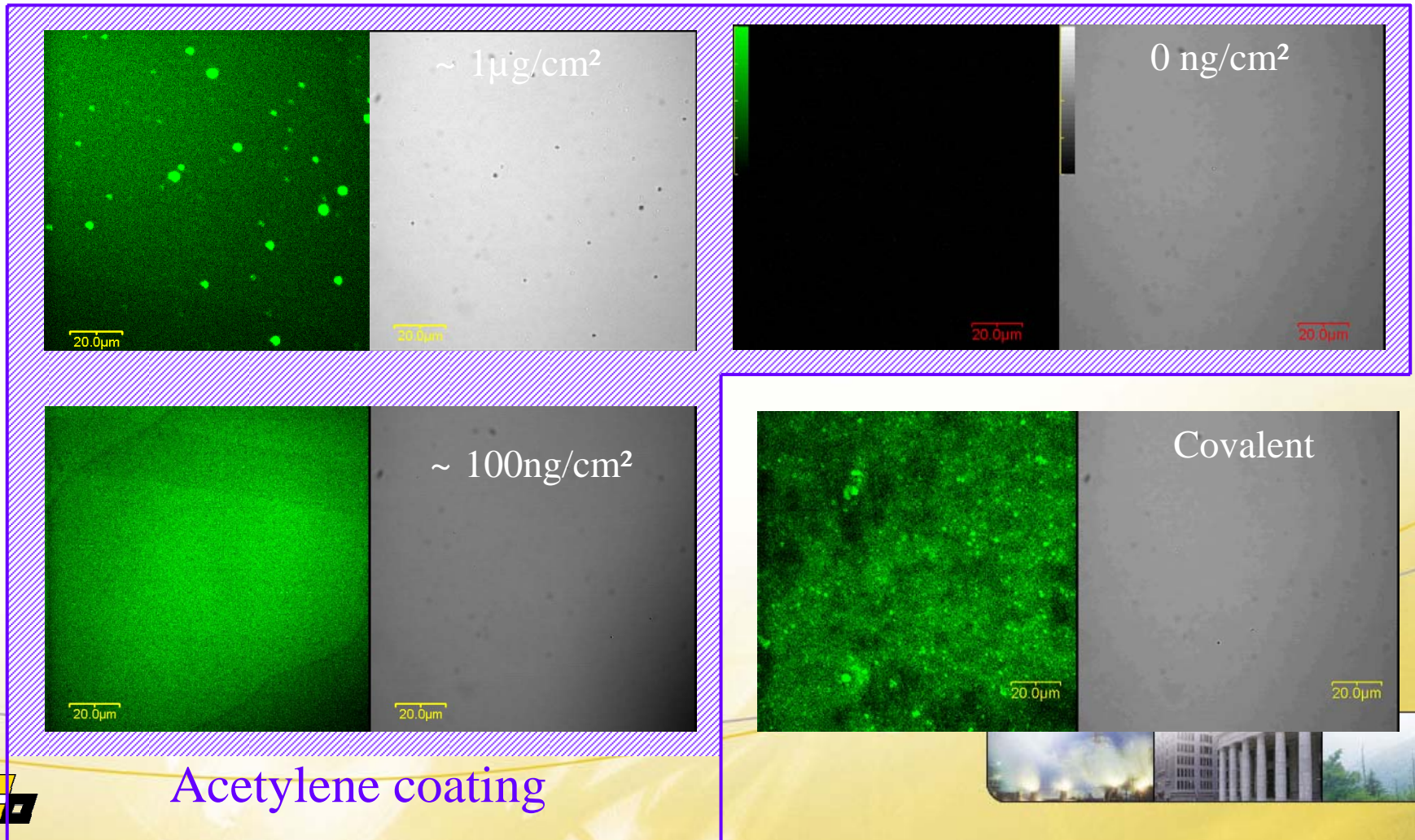


- W: ~ 15 nm
- R: ~ 10 nm
- H: ~ 20 nm

- Clusters of varying sizes and possibly single proteins
- Randomly dispersed in the coating

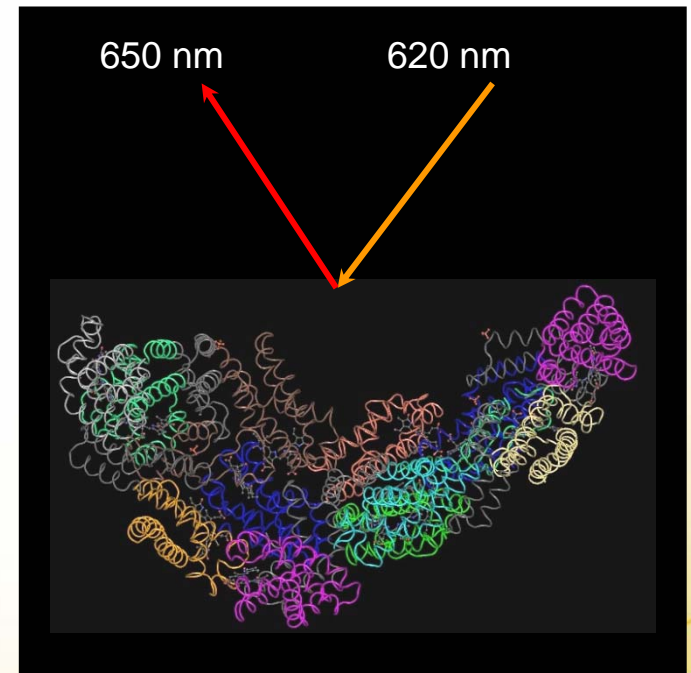
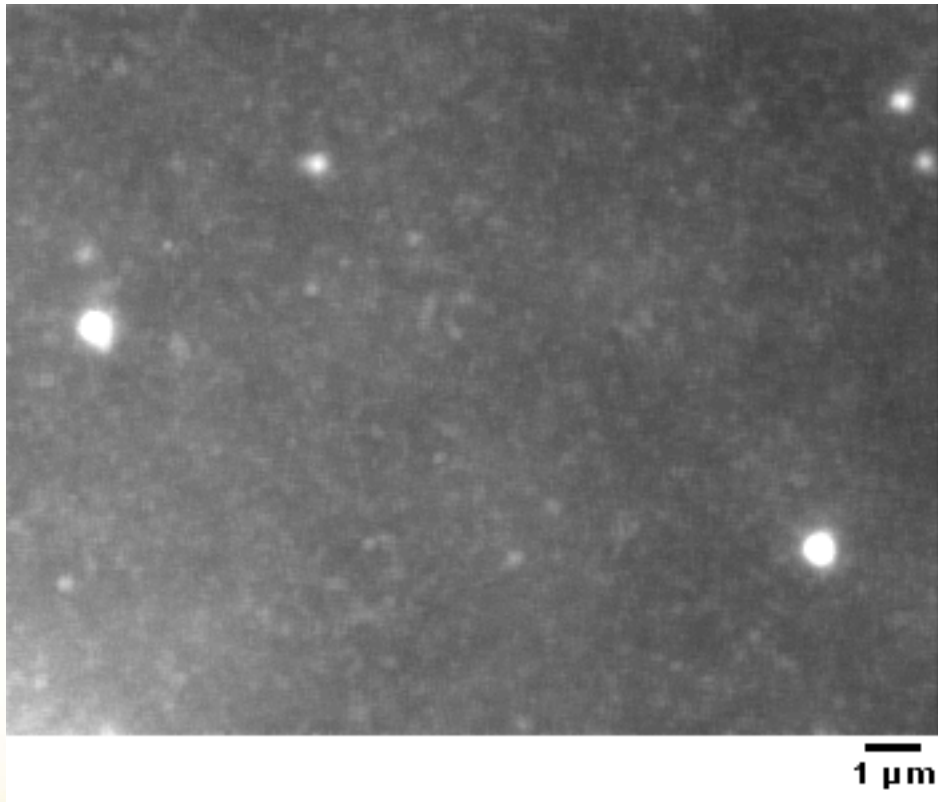


# Immobilization of biomolecules





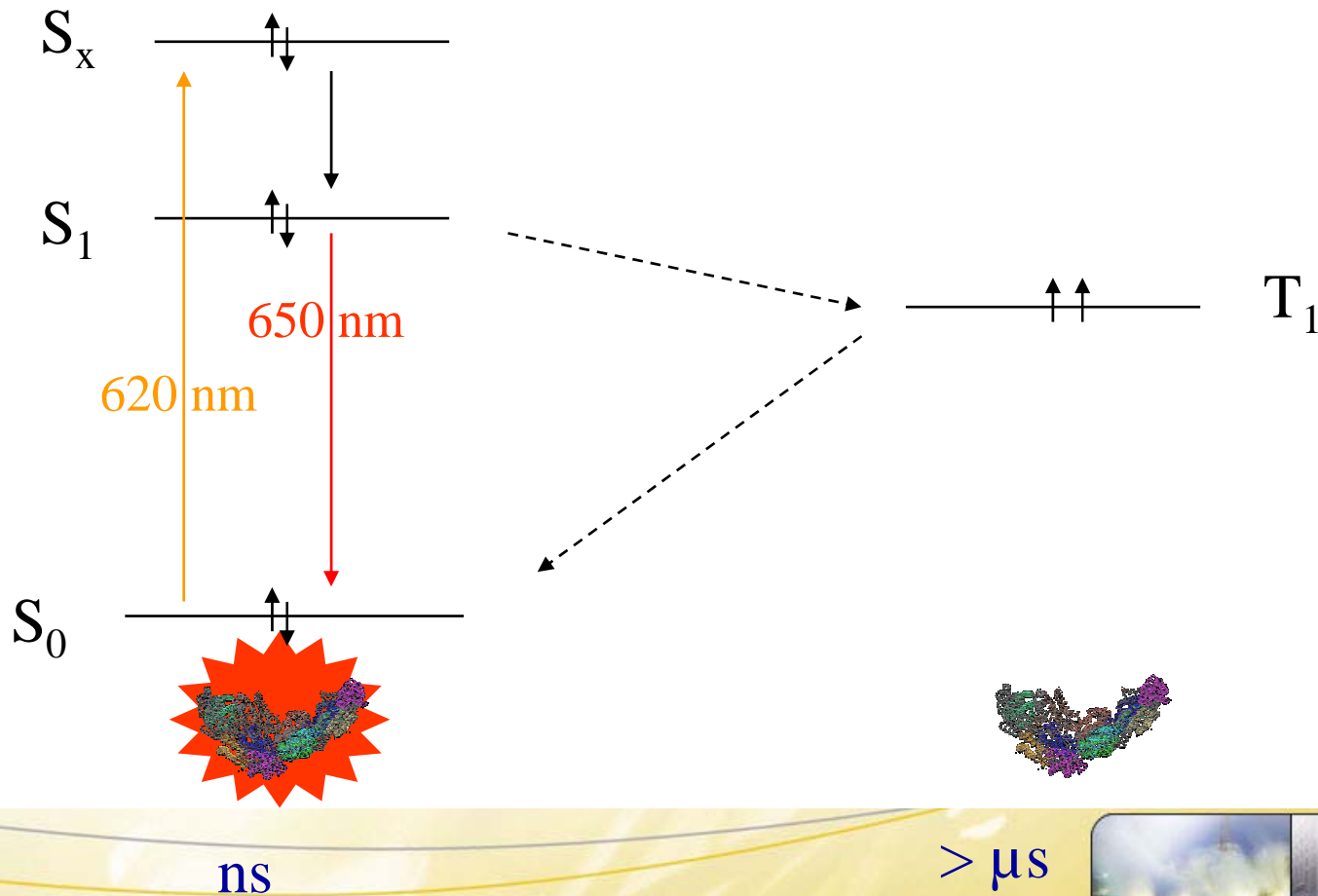
# Plasma's, proteins and Wide-field microscopy

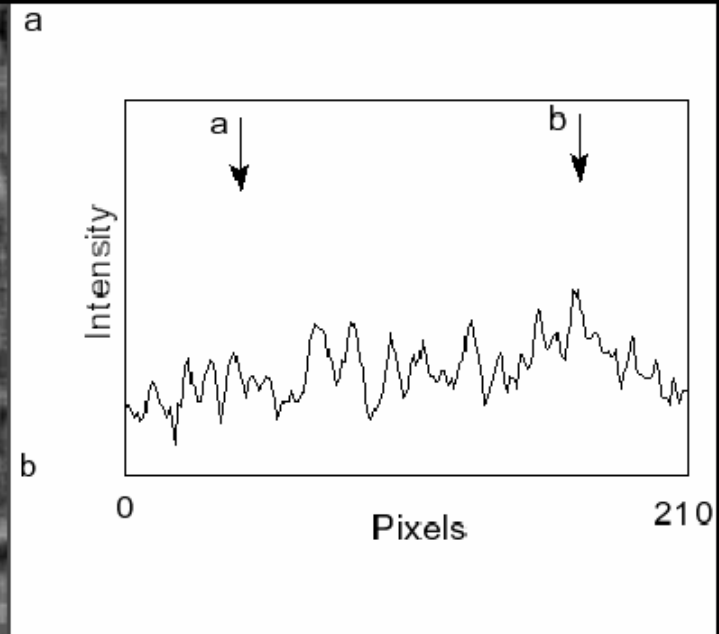
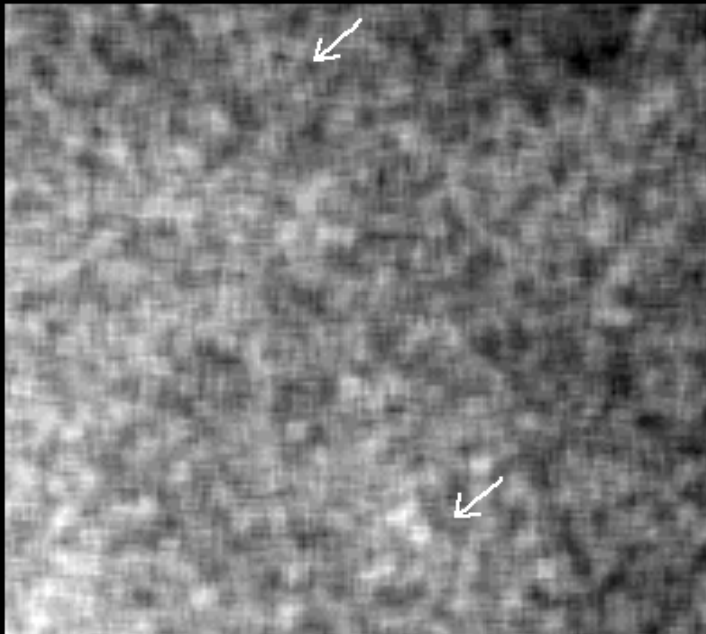
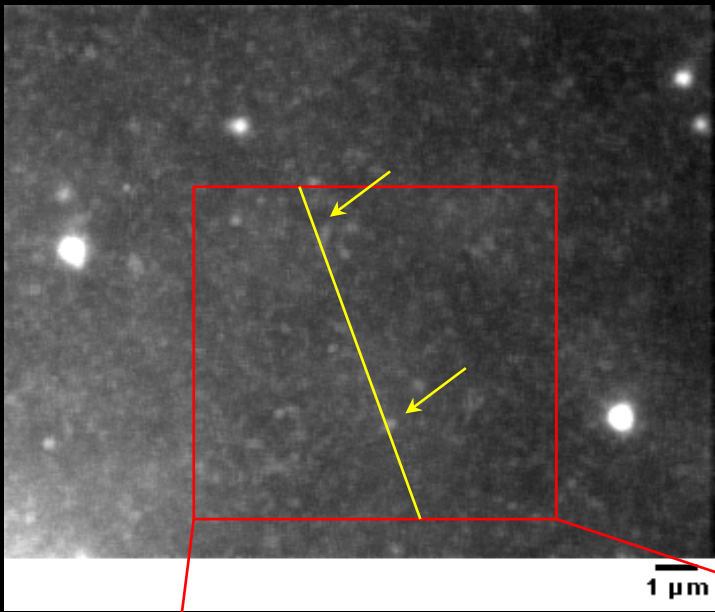


Allophycocyanin

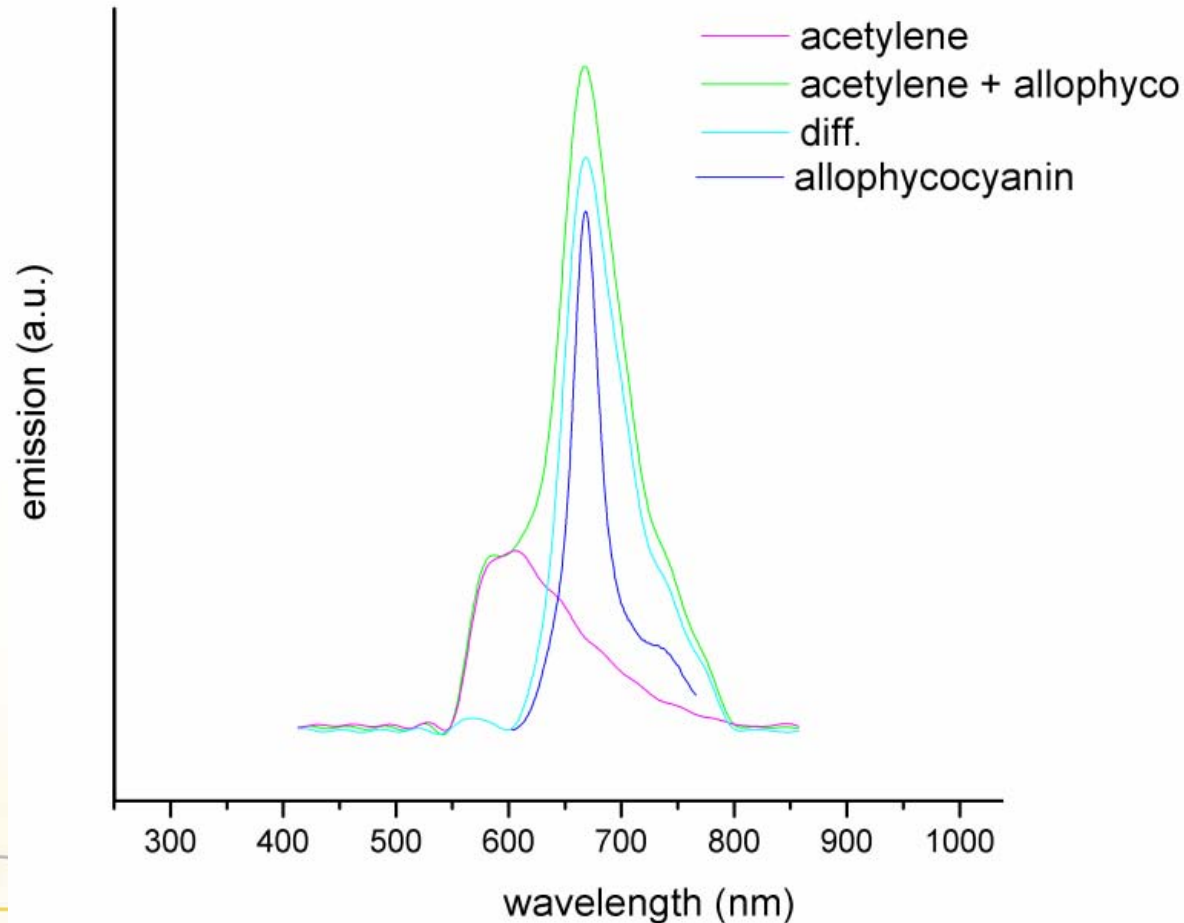


# Plasma's, proteins and Wide-field microscopy

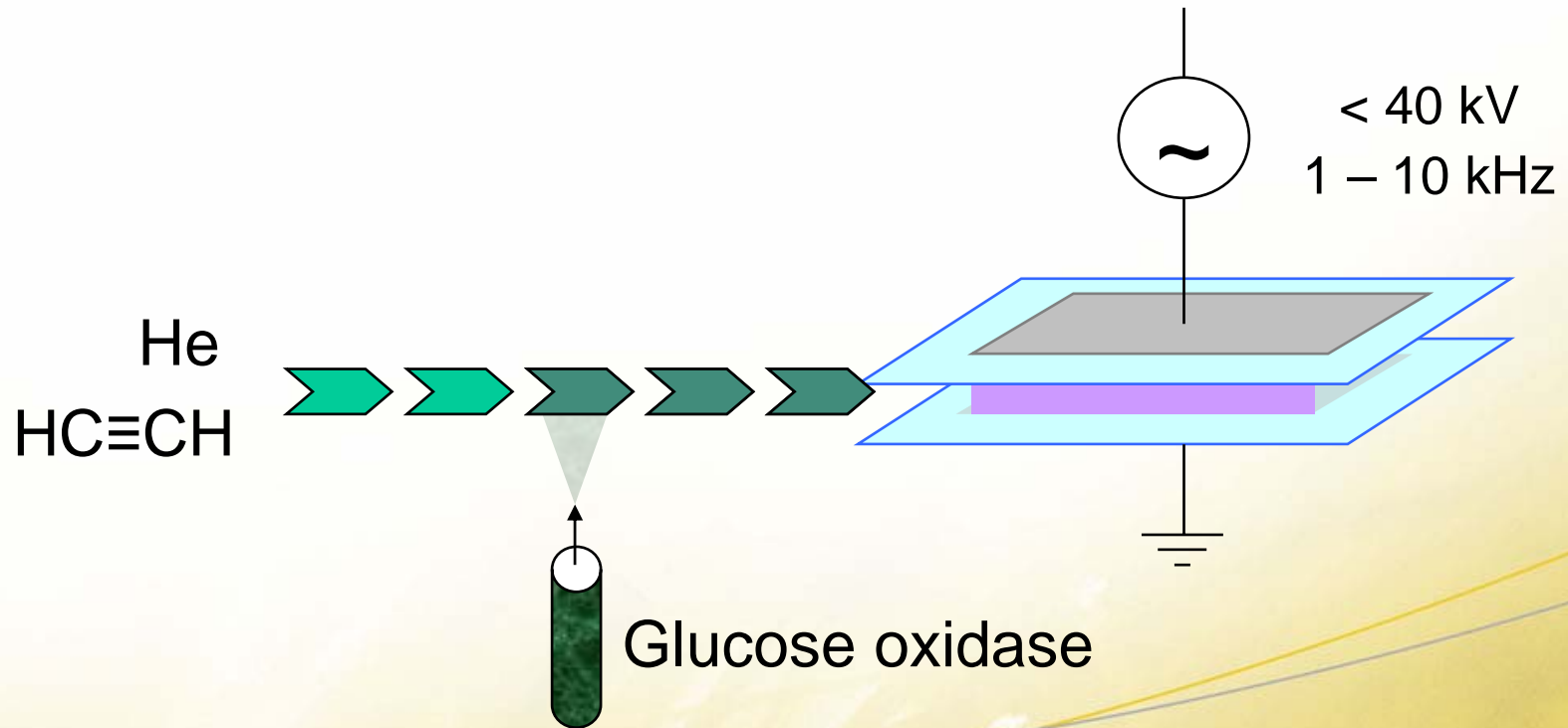




# Plasma's, proteins and Wide-field microscopy

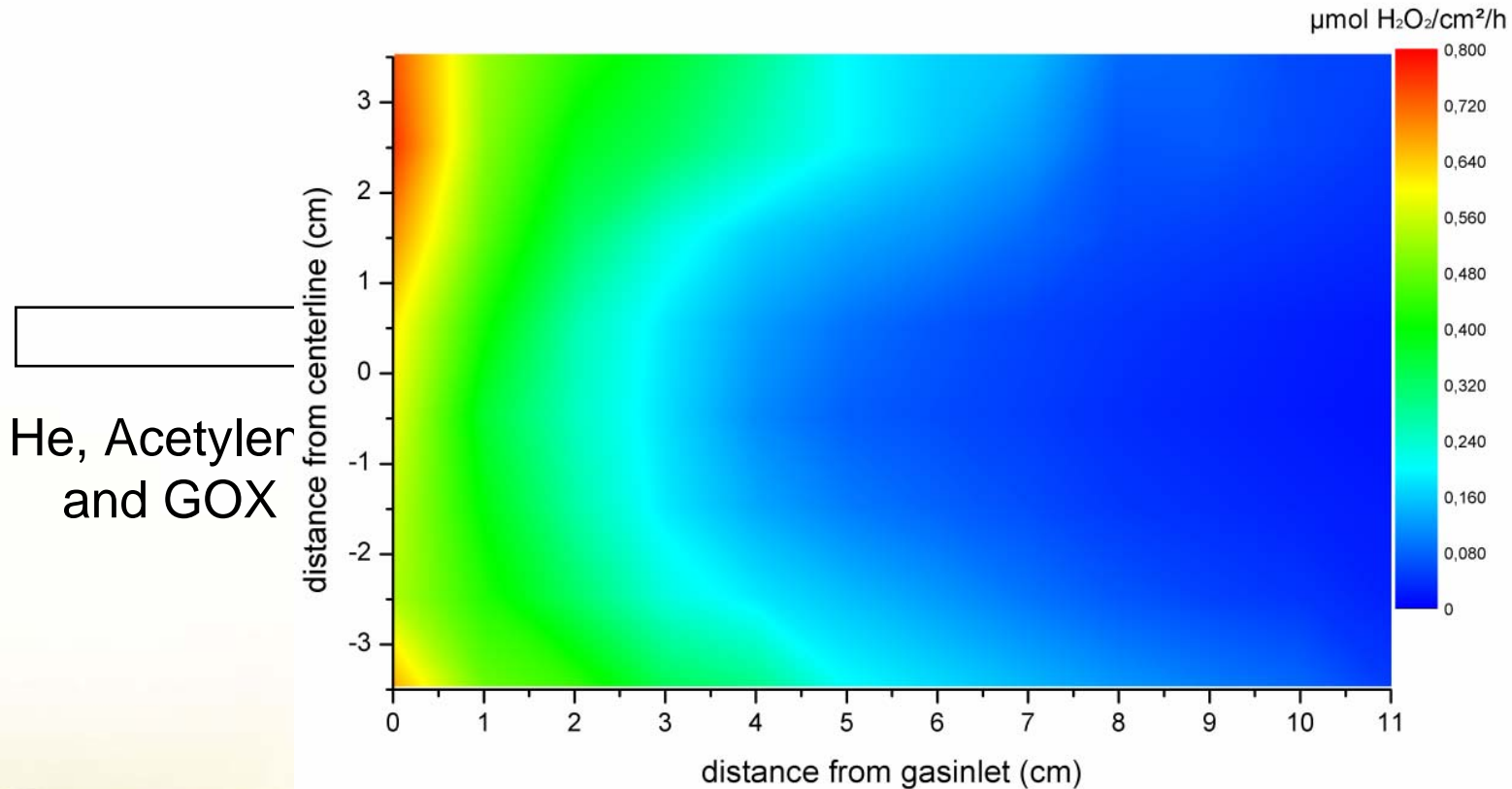


# Plasma's, enzymes and bio-functionality

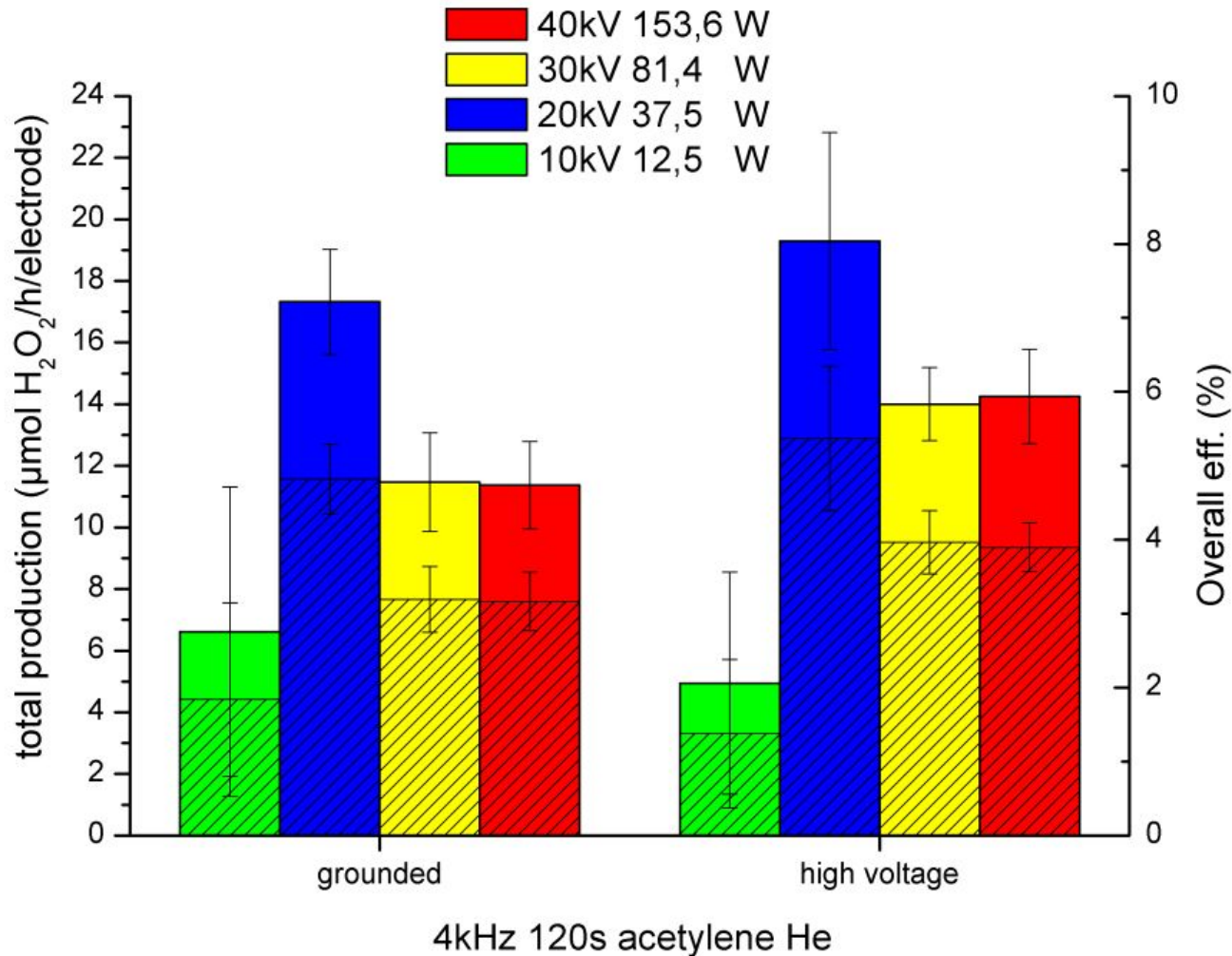




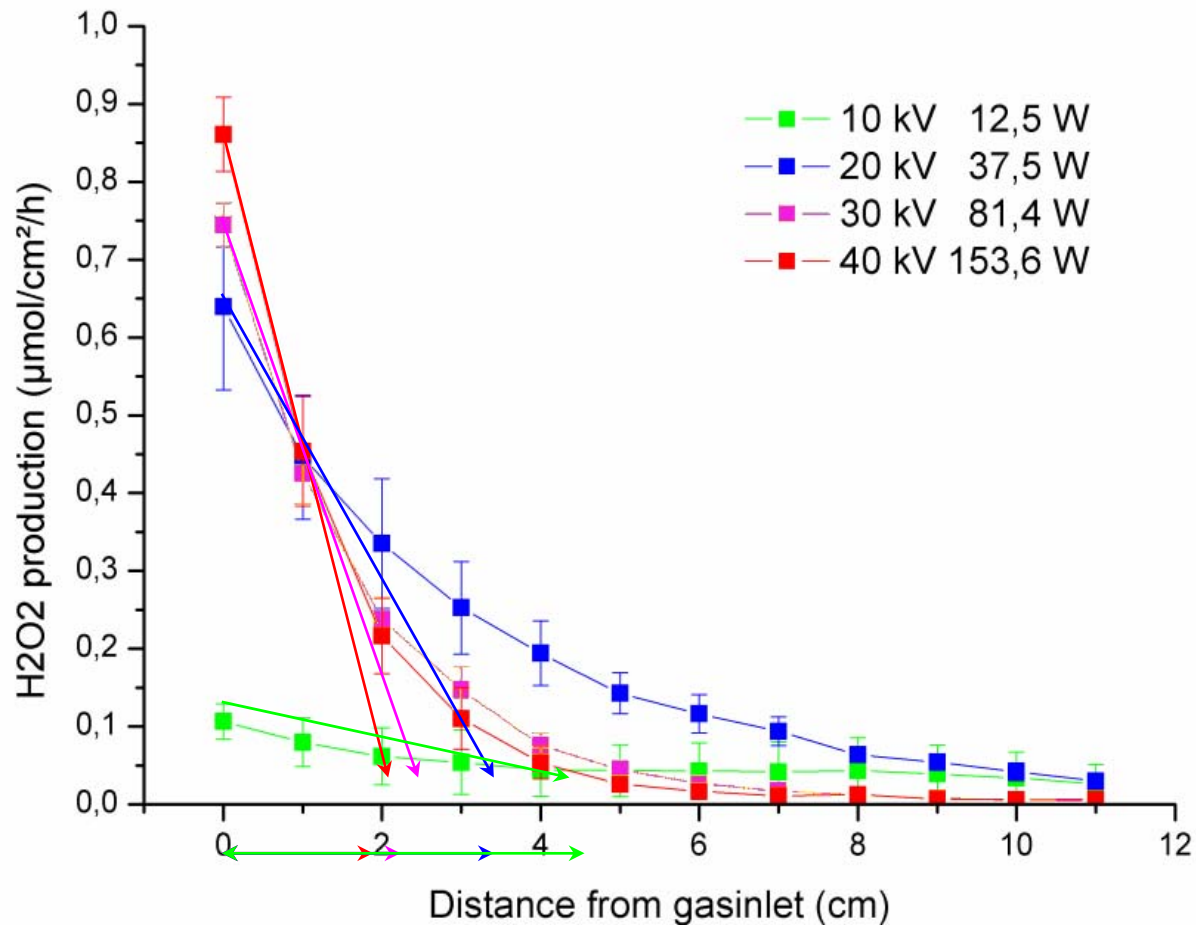
# Plasma's, enzymes and bio-functionality



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# Plasma's, enzymes and bio-functionality



# Conclusions

- Enzymes can resist mild plasma conditions
- Single step procedure is possible
- Fast (~ 60 – 120 s)
- Up to single protein dispersion

→ continuous / in-line processing is feasible

→ surface energy control

→ power and gas flow  $\Rightarrow$  deposition zone



# Future prospects

- How are the proteins bound ??
- Leaching behavior
- Shelf-life
- Evaluation of industrial implementation





# Acknowledgments



S. Paulussen



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M.B.J. Roeffaers  
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# Thank you for your attention

