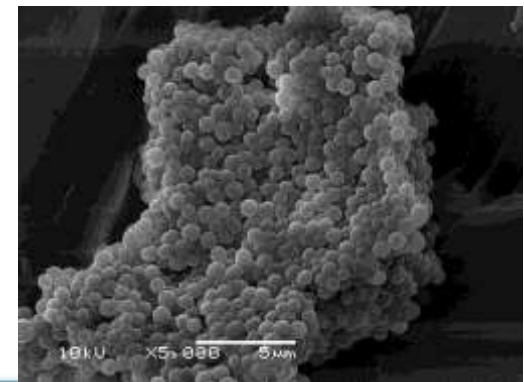




# Impedance analyses of biofilm formation of two *Staphylococcus aureus* strains under $\text{CuCl}_2$ or $\text{CuSO}_4$ influence

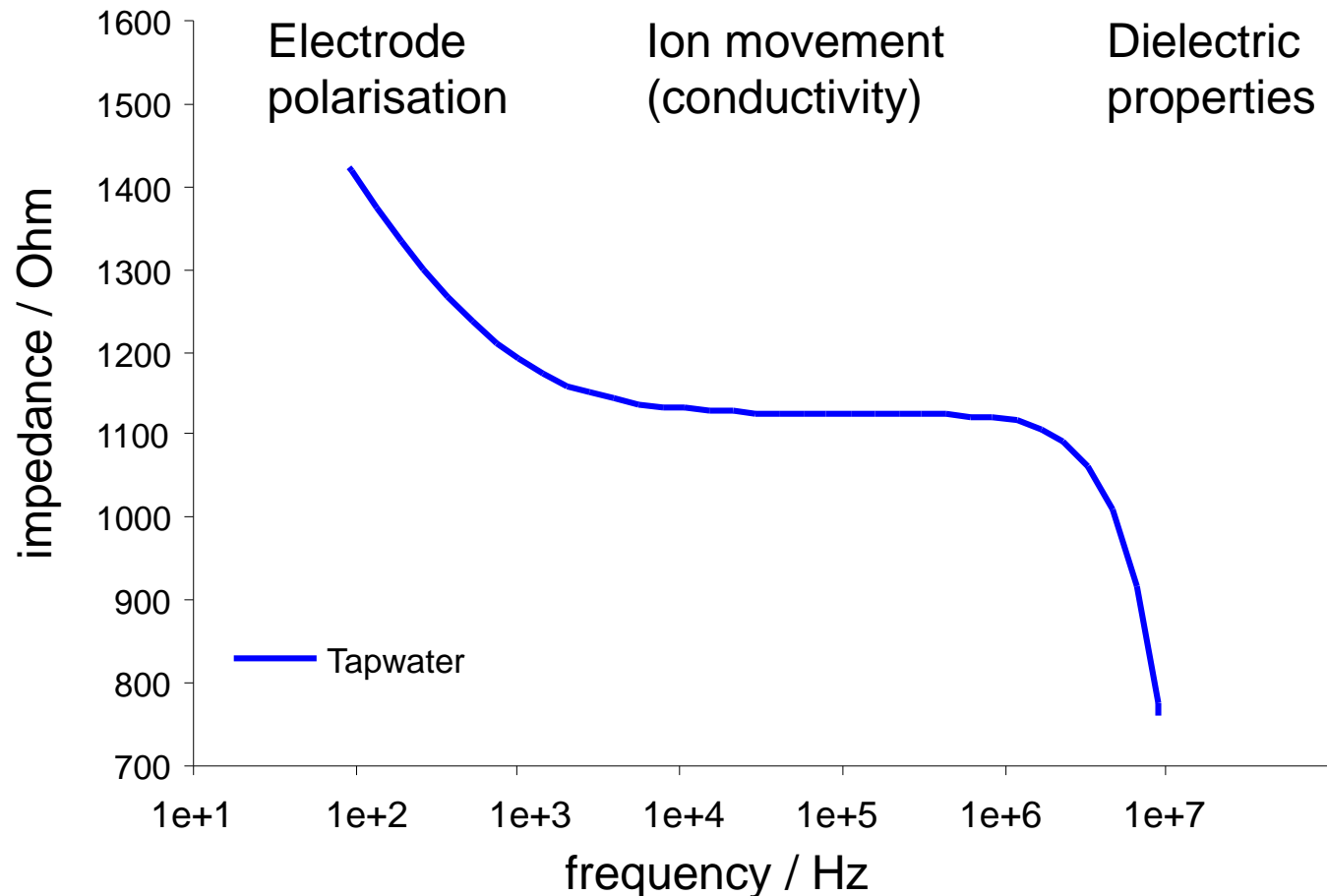
Dr. Astrid H. Paulitsch-Fuchs



# Electrical Impedance Spectroscopy (EIS)

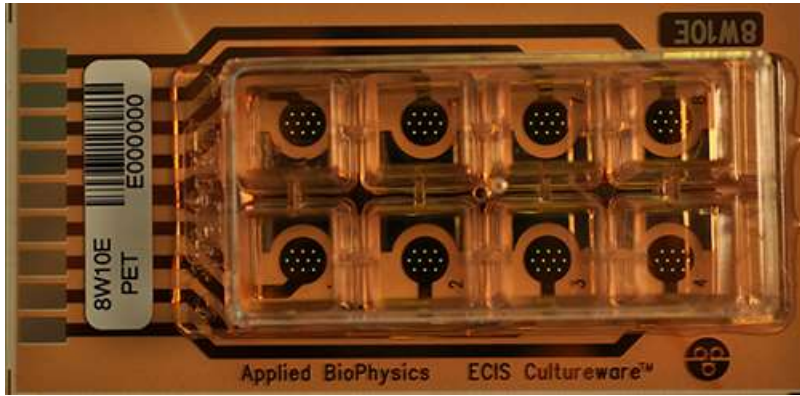
## Principles

Electrical impedance spectroscopy measures the impedance (electrical resistance) of a system over a range of frequencies.



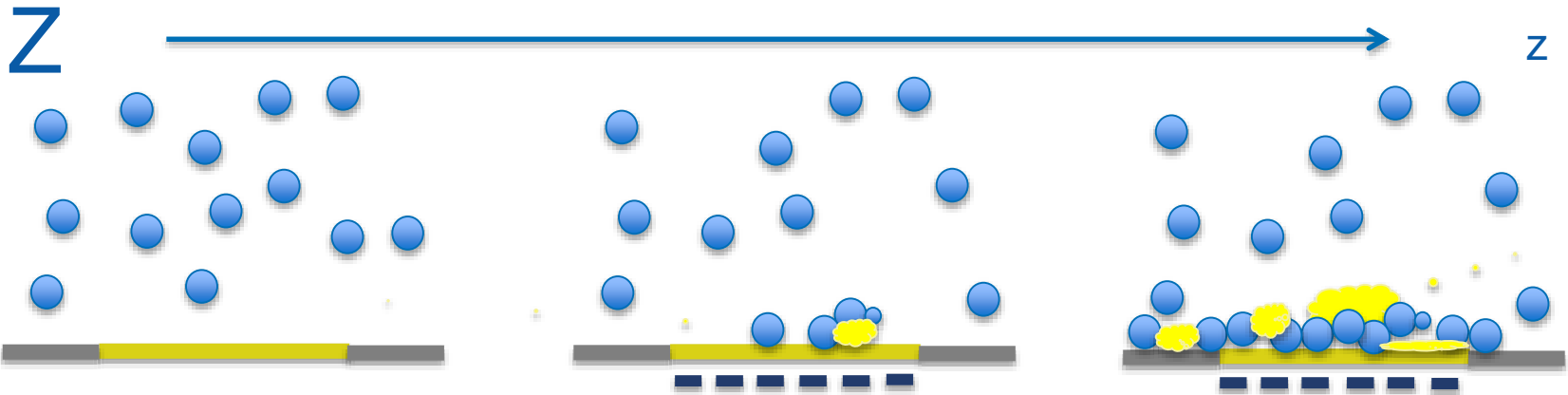
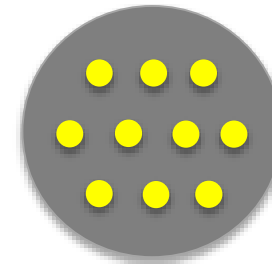
# Impedance

## Biofilm measurements



counter electrode

insulated area



# Impedance

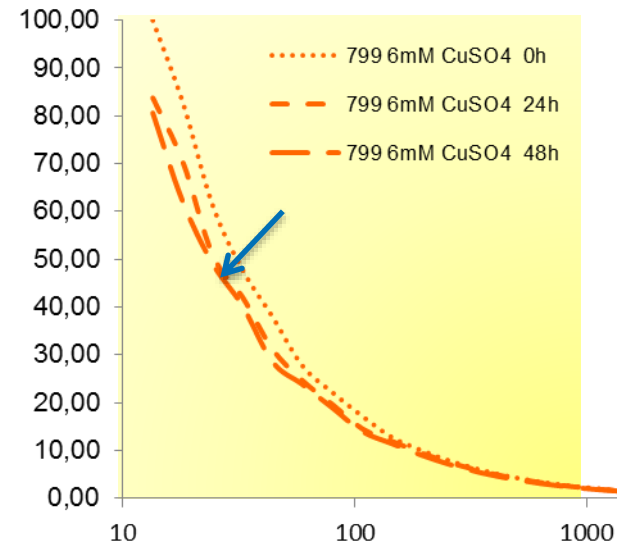
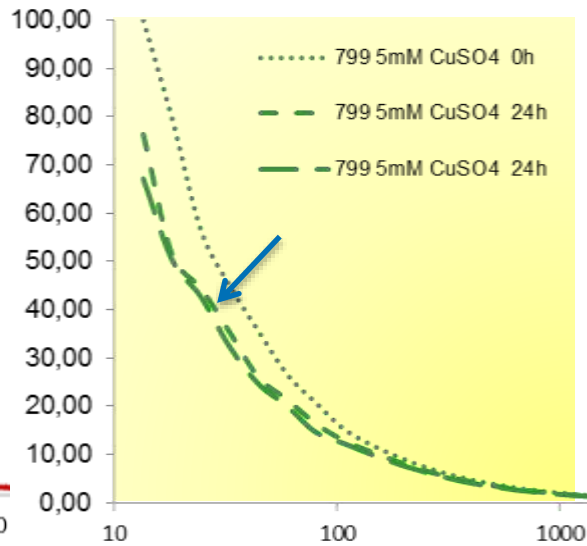
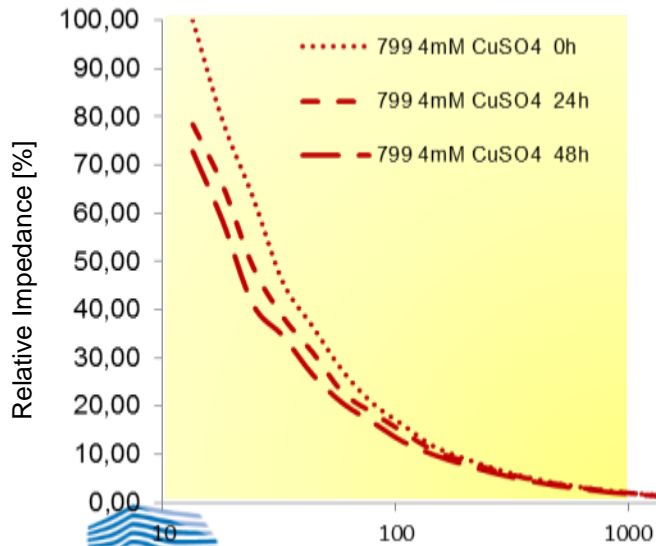
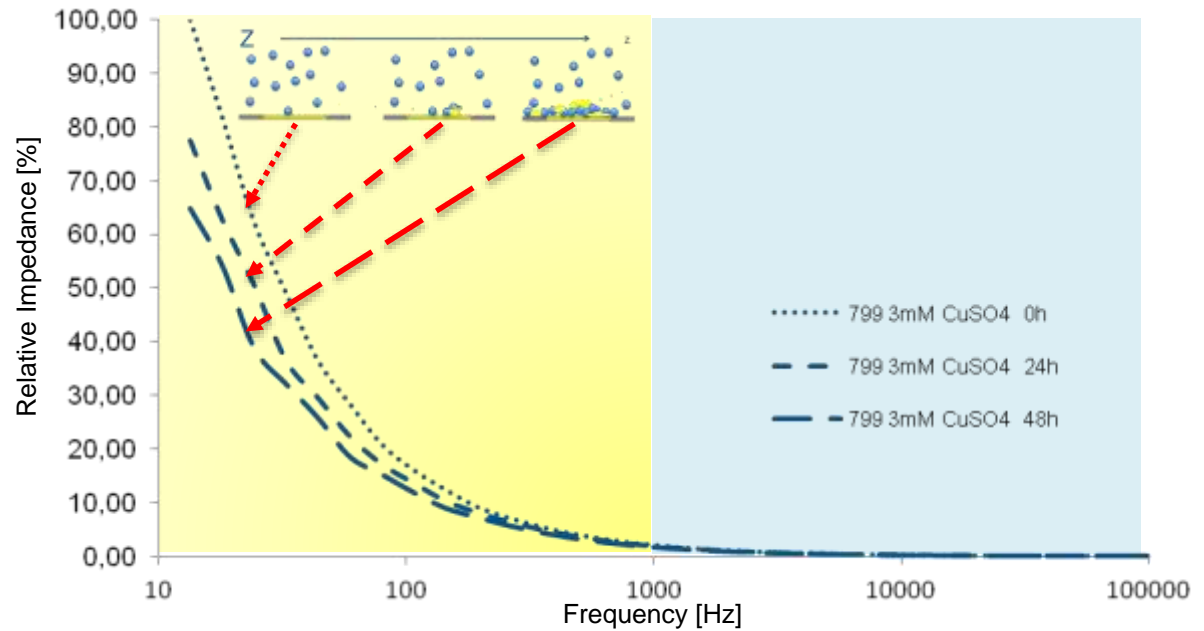
## Biofilm measurements

- *Staphylococcus aureus* biofilms grown for 48h in different concentrations of  $\text{CuCl}_2$  or  $\text{CuSO}_4$
- Impedance measured after 0, 24 and 48h
- Additionally typical laboratory testing for biofilms (polysaccharid and protein content, life/dead cells)

# S. aureus DSM799 CuSO<sub>4</sub>

Electrode polarisation  
(0-1000 Hz)

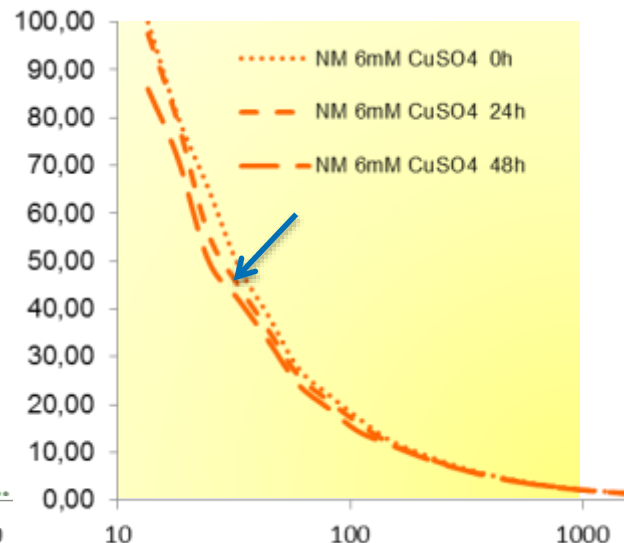
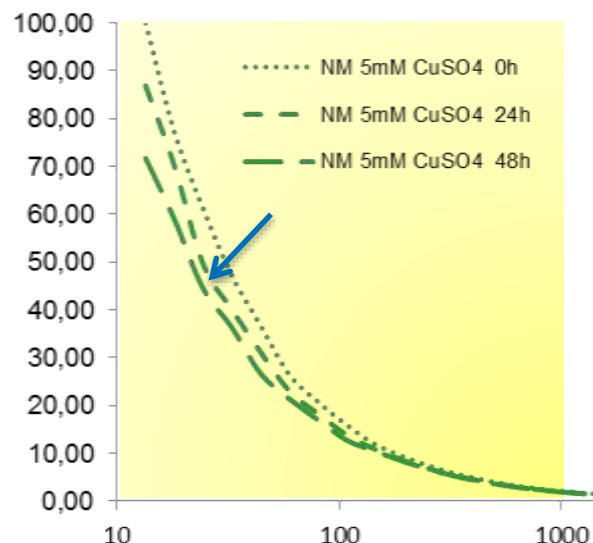
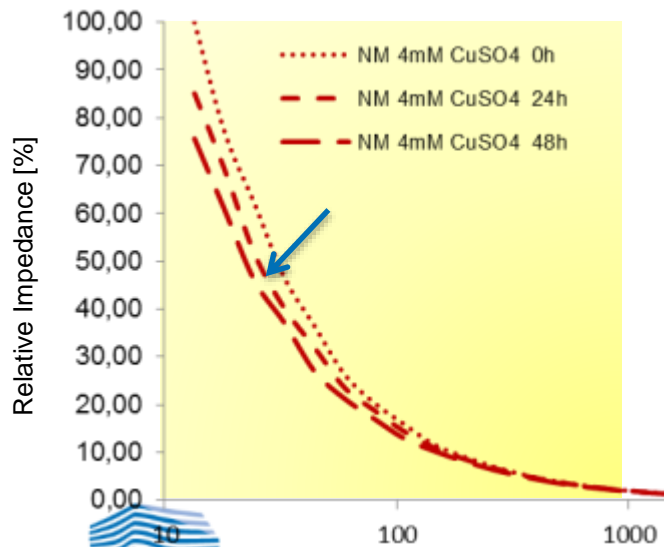
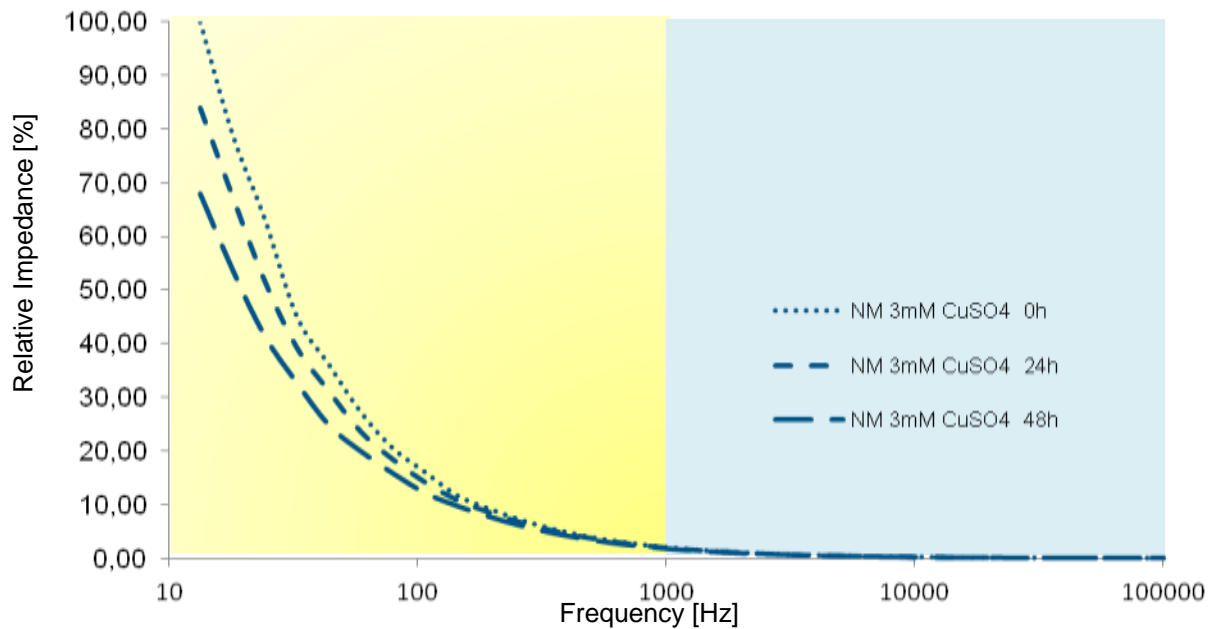
Conductivity of the  
solution (>1000 Hz)



# S. aureus Newman CuSO<sub>4</sub>

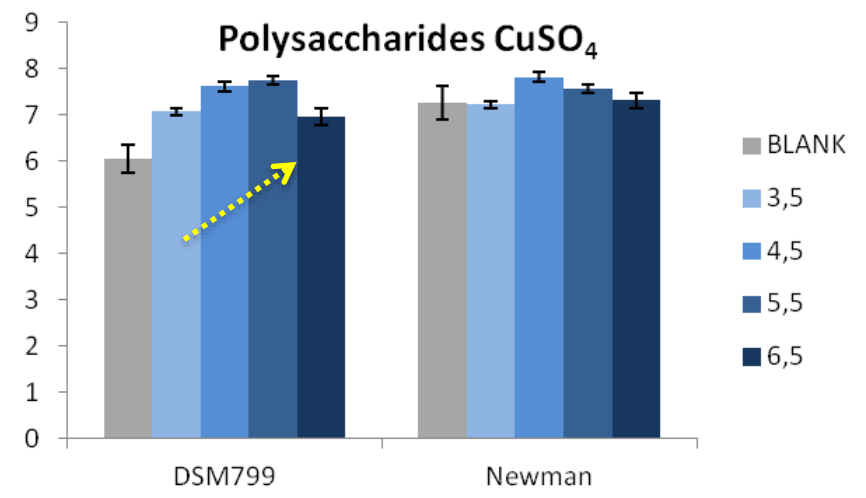
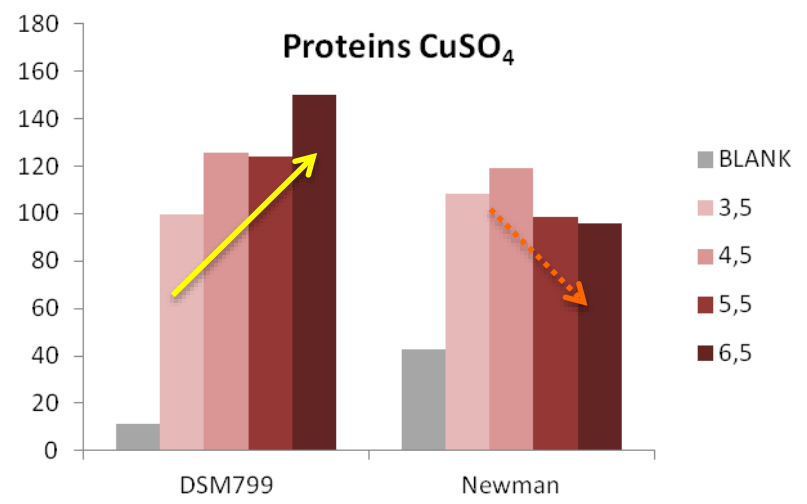
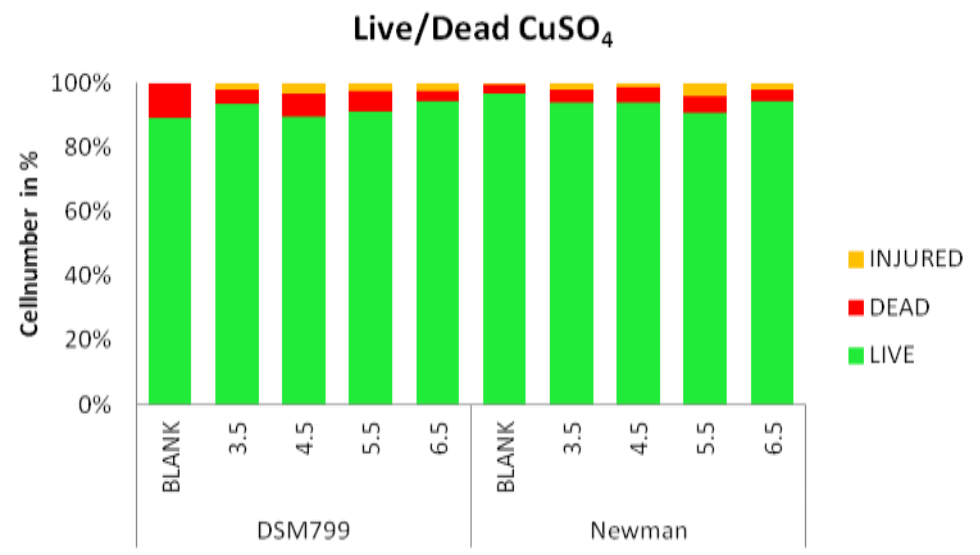
Electrode polarisation  
(0-1000 Hz)

Conductivity of the  
solution (>1000 Hz)



# Flow cytometry, proteins and polysaccharides

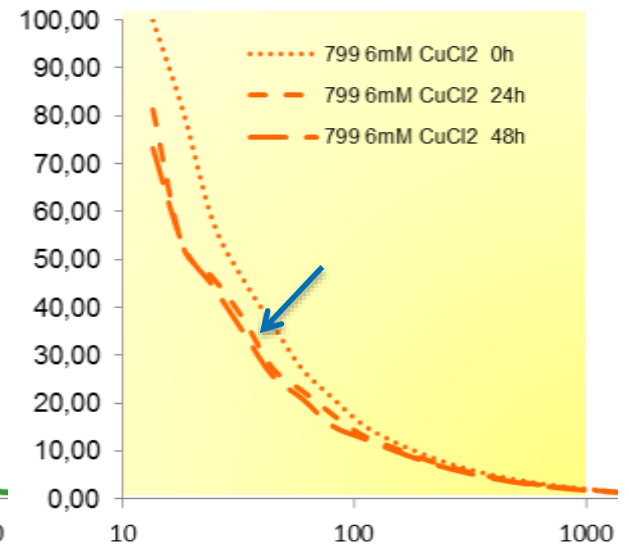
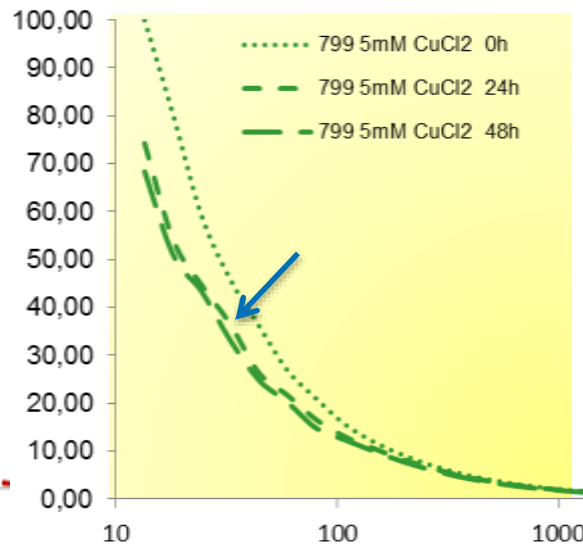
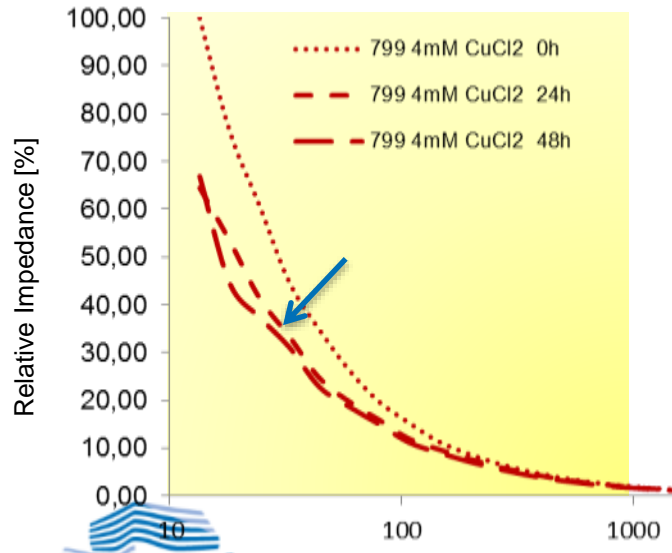
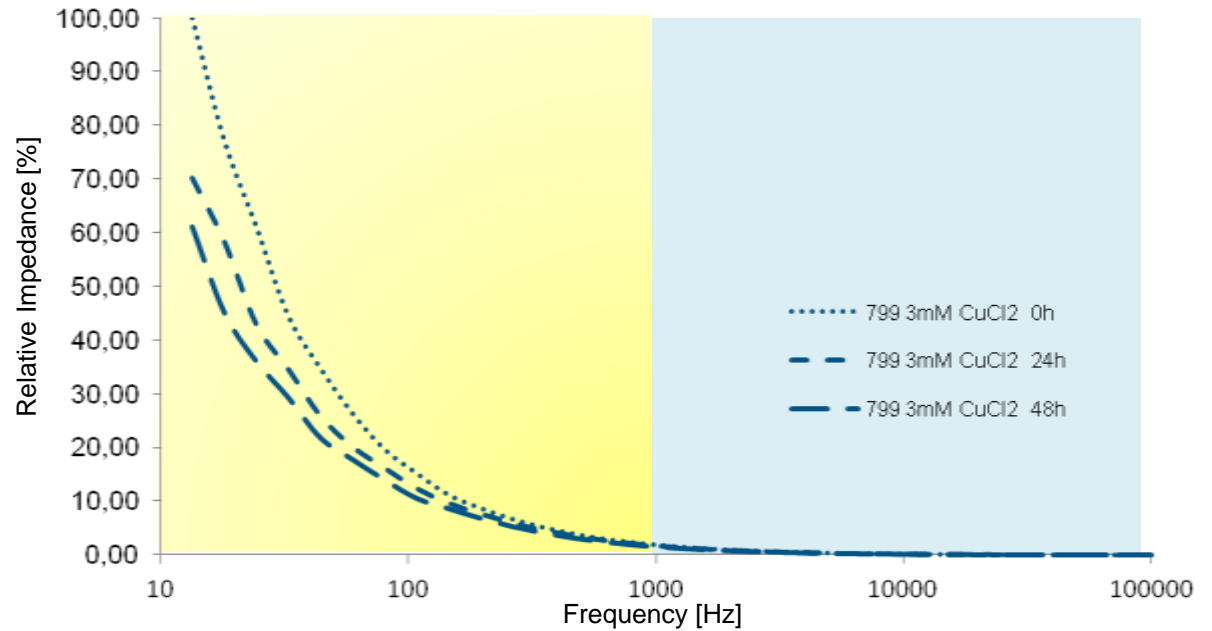
## *S. aureus* DSM799 and Newman $\text{CuSO}_4$



# S. aureus DSM799 CuCl<sub>2</sub>

Electrode polarisation  
(0-1000 Hz)

Conductivity of the  
solution (>1000 Hz)

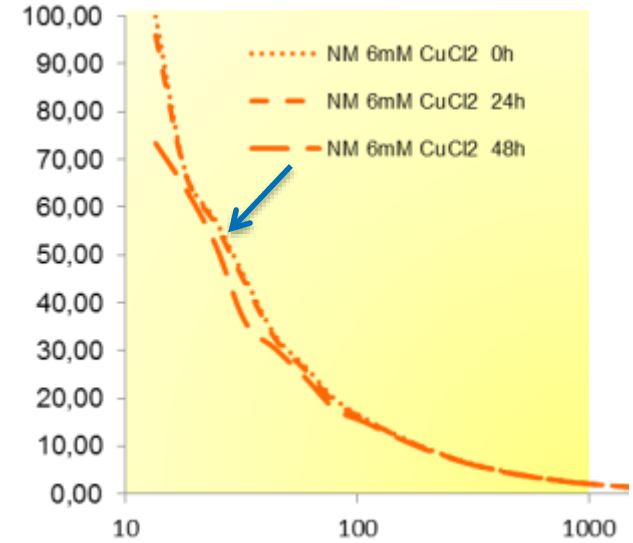
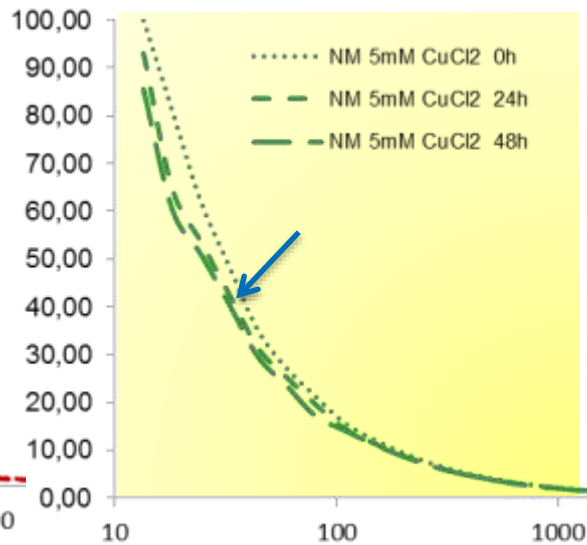
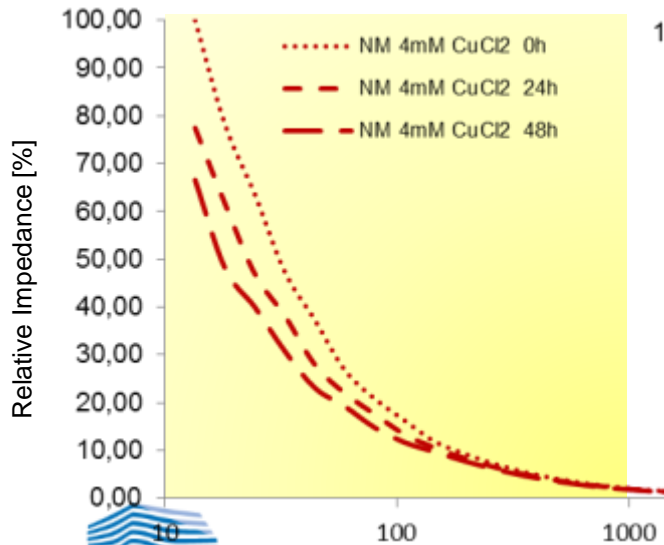
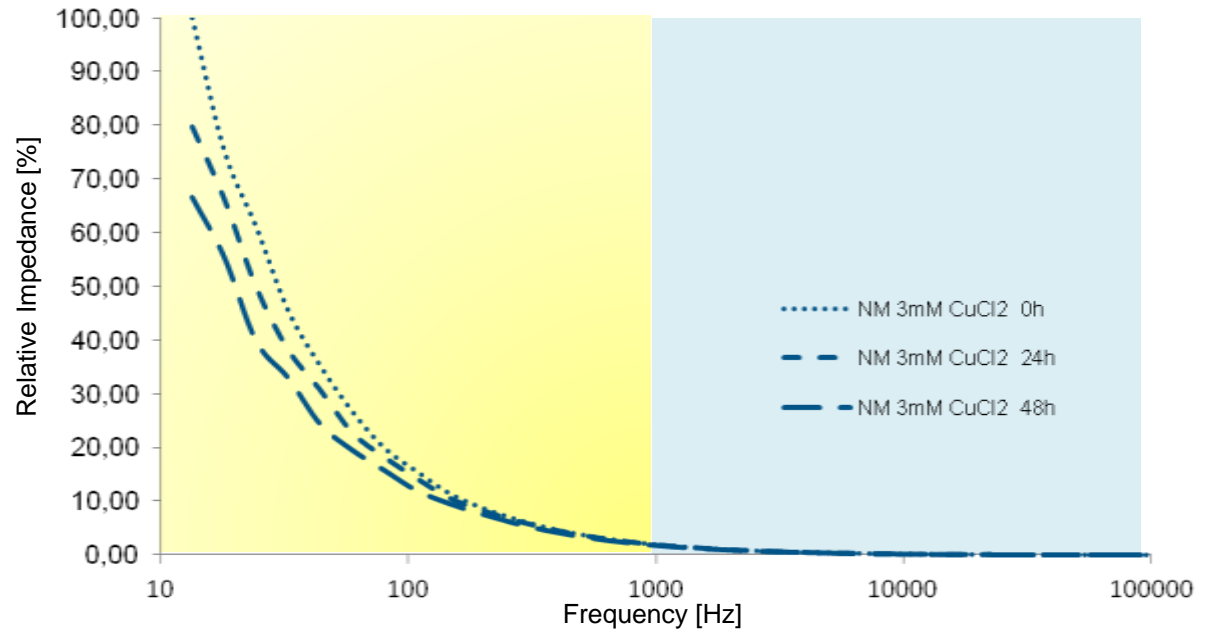




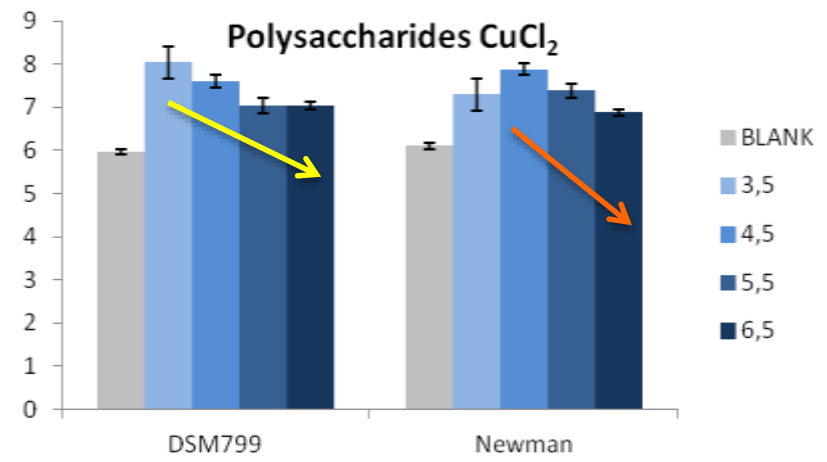
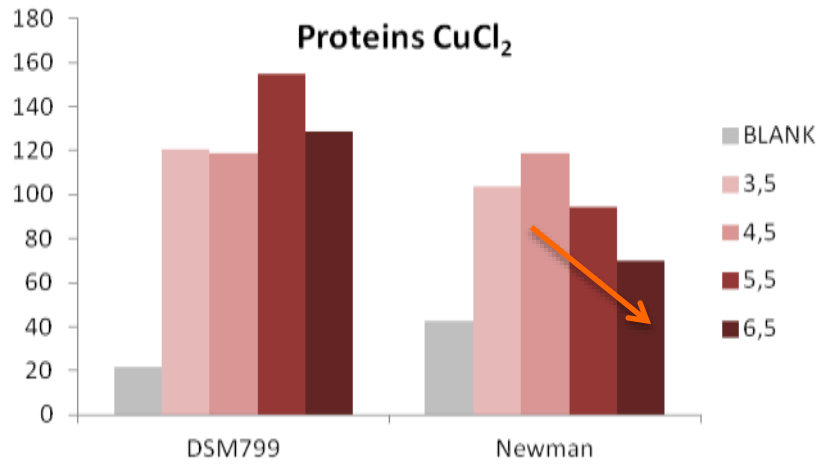
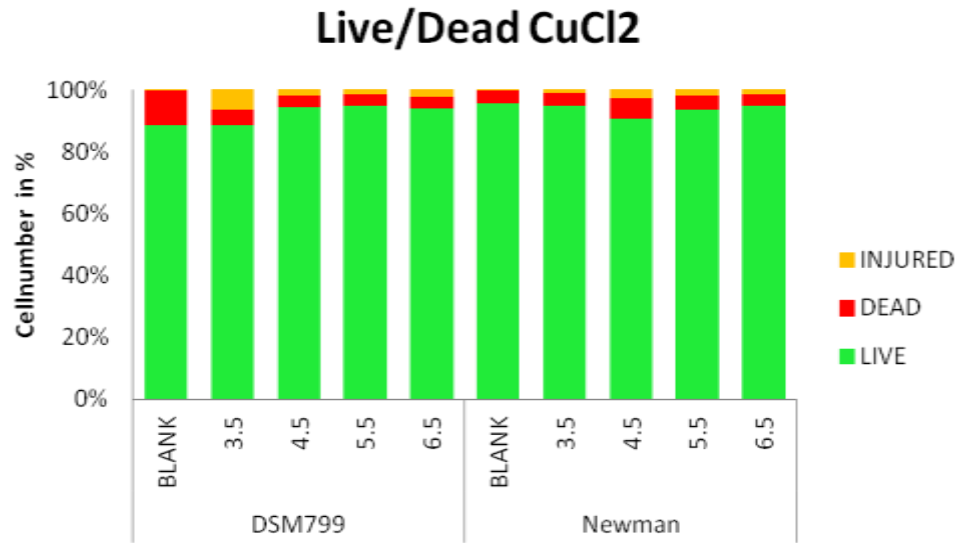
# S. aureus Newman CuCl<sub>2</sub>

Electrode polarisation  
(0-1000 Hz)

Conductivity of the  
solution (>1000 Hz)



# Flow cytometry, proteins and polysaccharides *S. aureus* DSM799 and Newman $\text{CuCl}_2$



# Impedance biofilm measurements

## Conclusions

- **CuCl<sub>2</sub> has a higher activity against biofilm formation of *S. aureus* Newman and DSM799 than CuSO<sub>4</sub>**
- ***S. aureus* Newman is more susceptible to the influences of Copper salts compared to DSM799**
- **Impedance analyses gives interesting insights in biofilm development, allowing to follow the formation / inhibition at a early stage even online**
- **Future studies are planned with higher time resolution and different organisms/materials**



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