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CENTER
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Comparison of Electrochemical Systems for Sensing Redox Active Molecules

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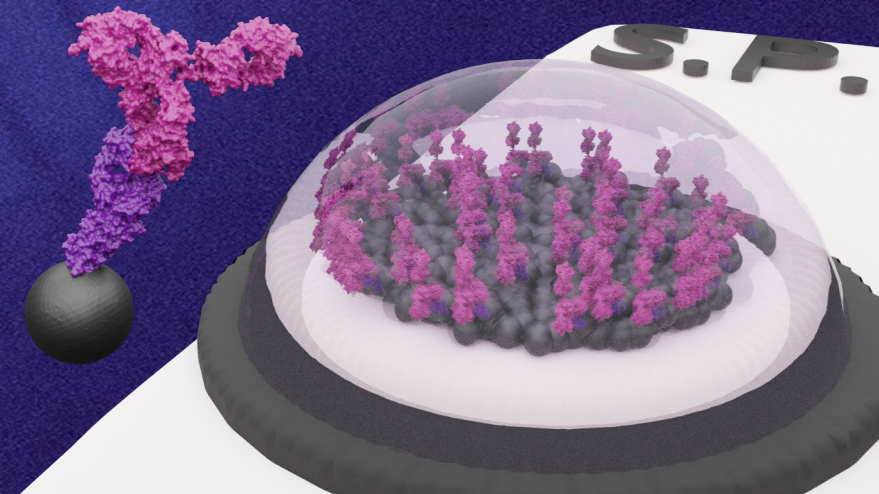
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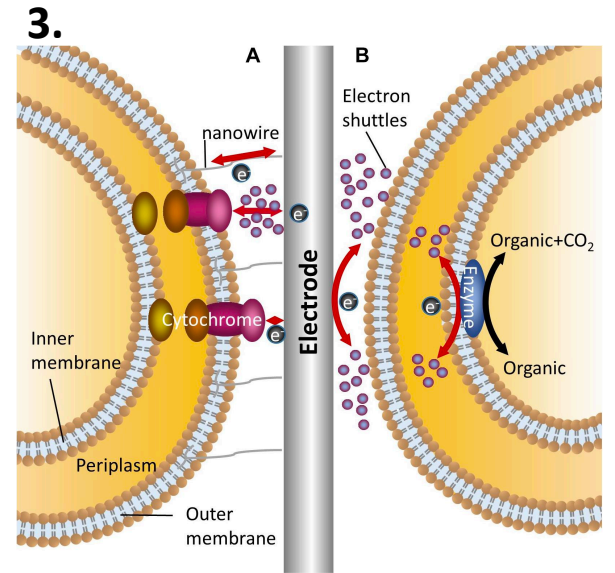


Marius Jakulis
Jason foundation

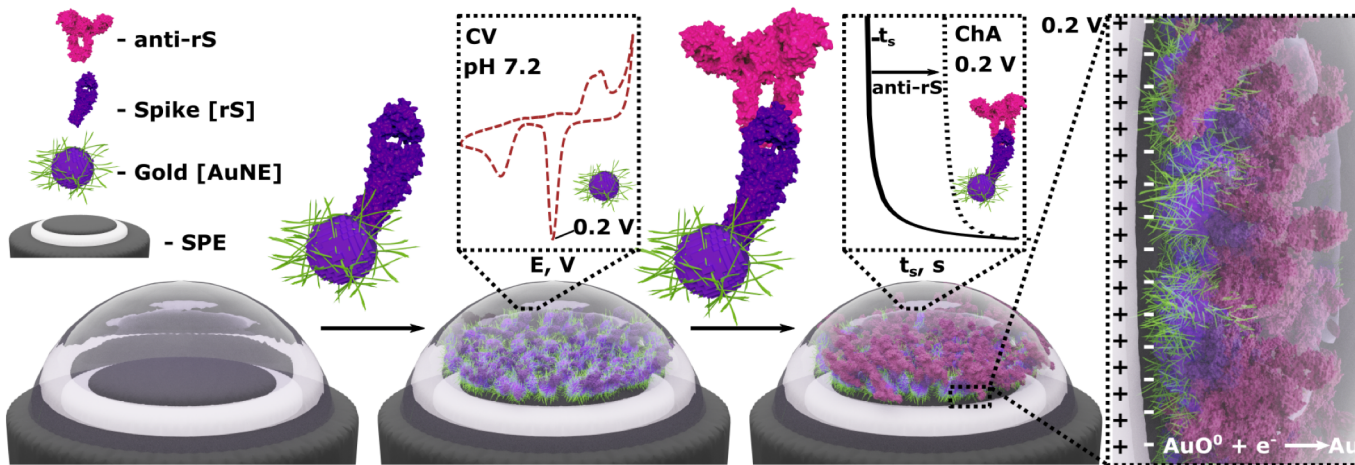


Research Field

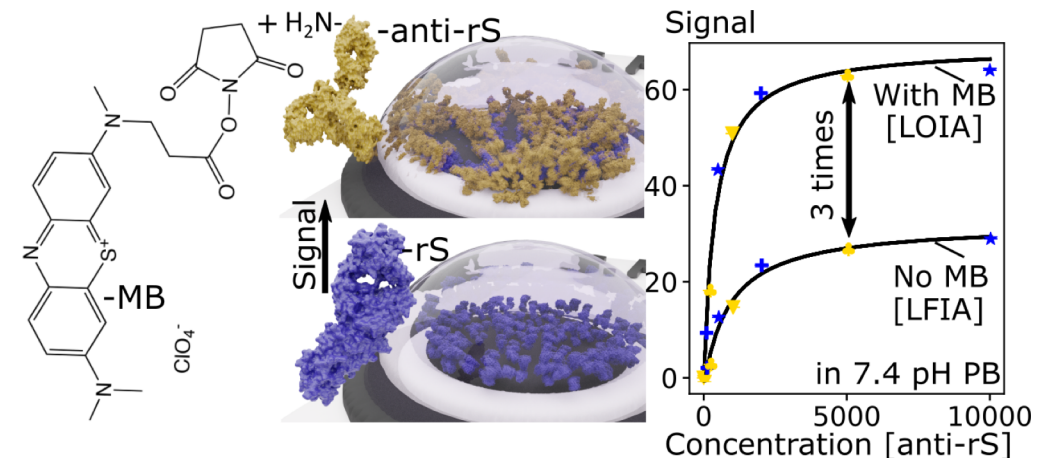
1. Electrochemical detection of antibodies against SARS-CoV-2 Spike protein based on miniaturised platforms
2. Electrochemical investigation of potential drugs against SARS-CoV-2 Spike protein
3. Microbial Electrochemistry for investigation of electron transfer for application to microbial electrochemical cells anodes



1.



2.



Work will be performed in collaboration of previous international research groups and LtD Delta Biosciences

What are biomarkers and why are they important?

Indicators in disease process

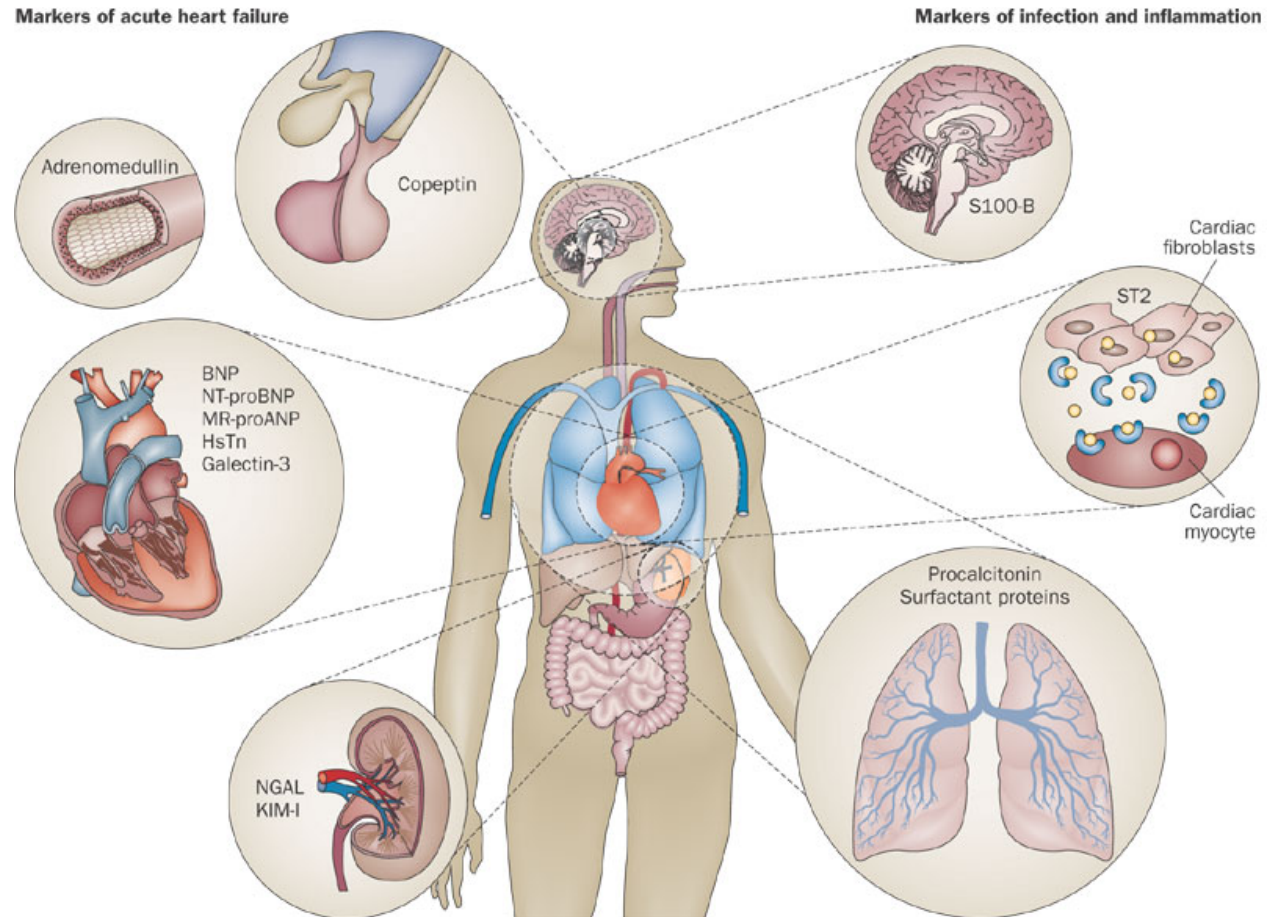
- Nucleic acids
- Proteins
- Small molecules

Improving the quality of life by

- Identification of disease
- Monitoring of disease-preventing organ (liver, kidney, heart and lung) injury into organ failure
- Effective disease treatment in advance

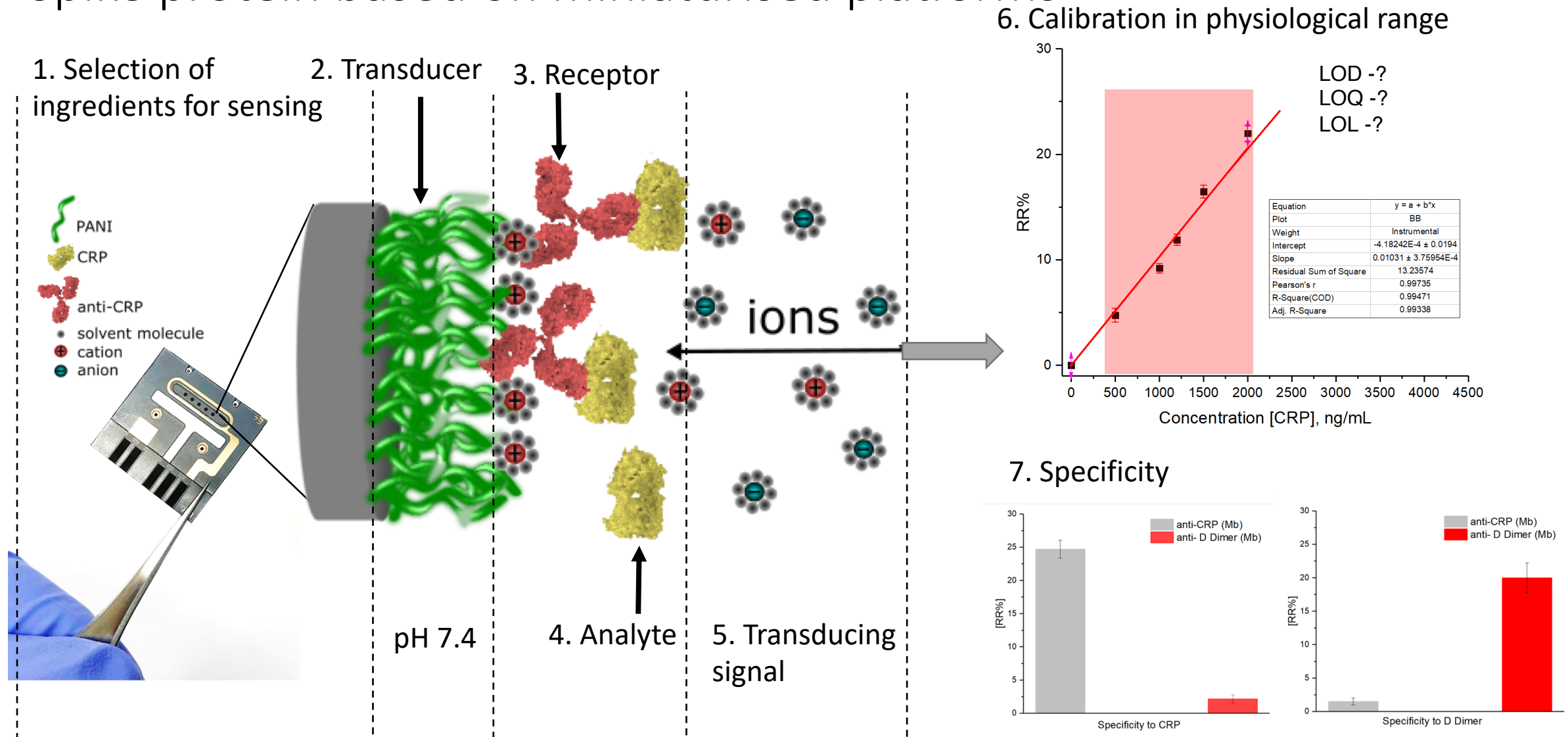
How to improve biosensing?

- using a panel of biomarkers, provides greater sensitivity and specificity

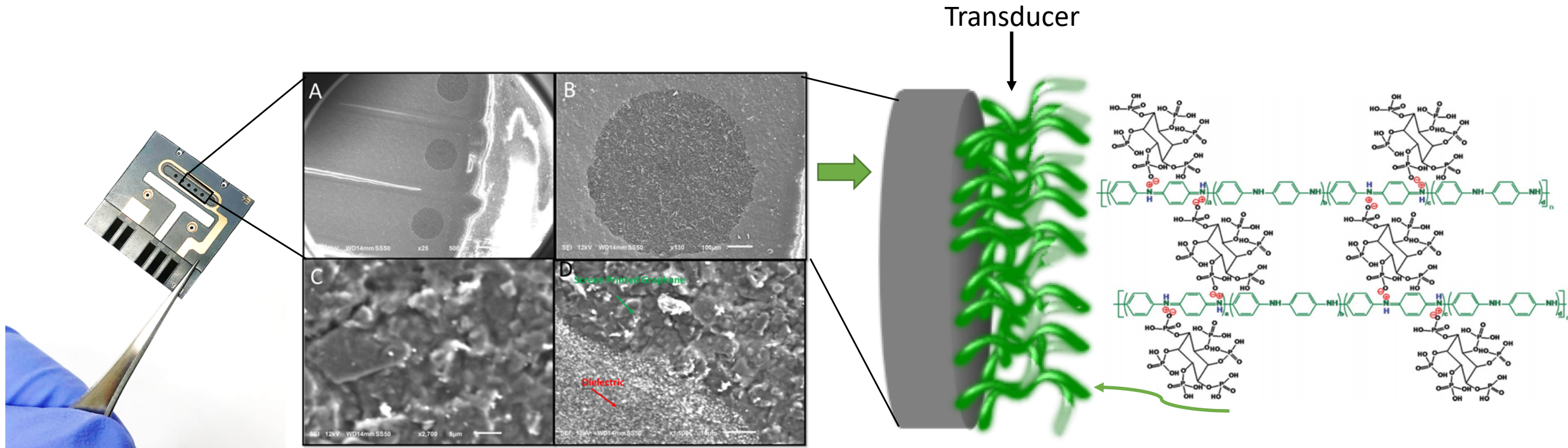


Biomarkers and their organ-specific release sites

Electrochemical detection of antibodies against SARS-CoV-2 Spike protein based on miniaturised platforms



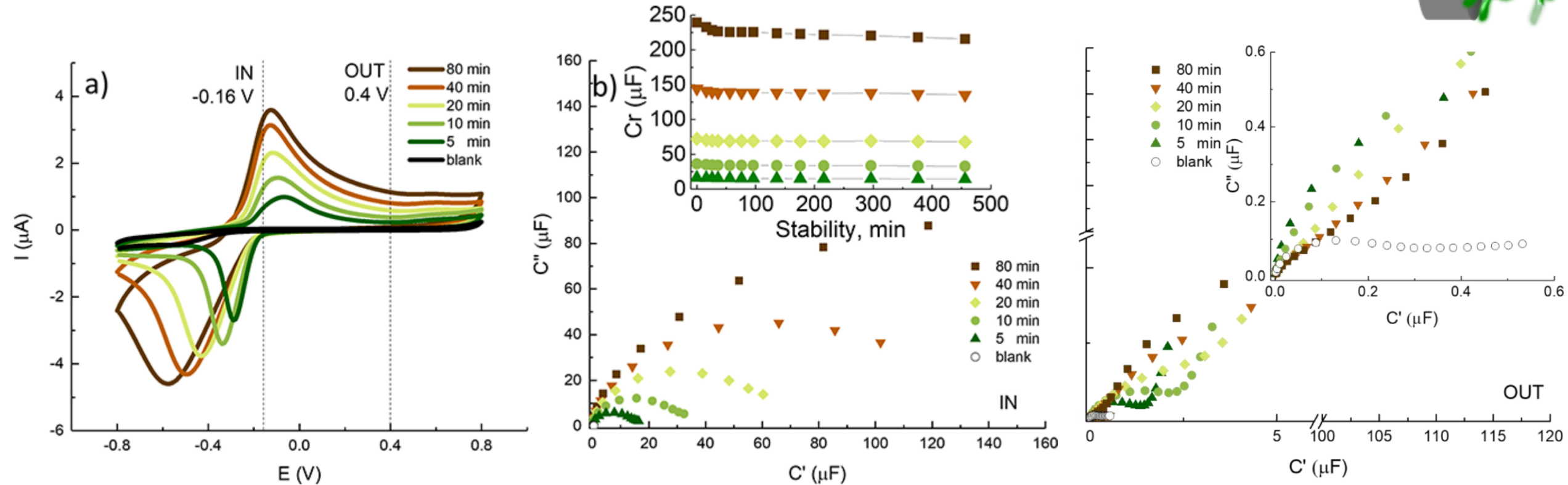
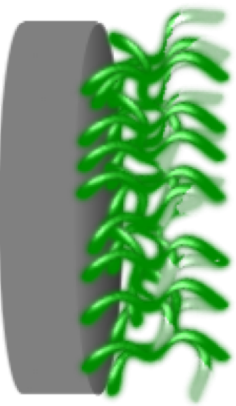
Electrochemical detection of antibodies against SARS-CoV-2 Spike protein based on miniaturised platforms



SEM micrographs of SPGNPE chip - A, single working electrode - B, zoom in screen printed graphene - C, edge of electrode and dielectric (screen printed on top of graphene) used for sealing - D. showing structure of graphene ink and dielectric used for sealing of the electrode.

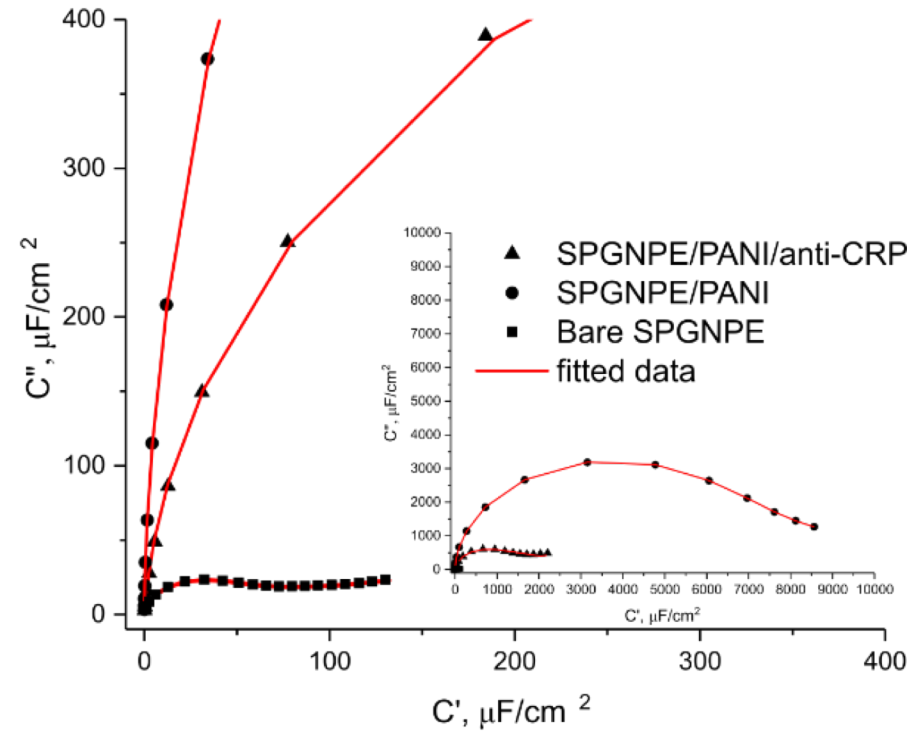
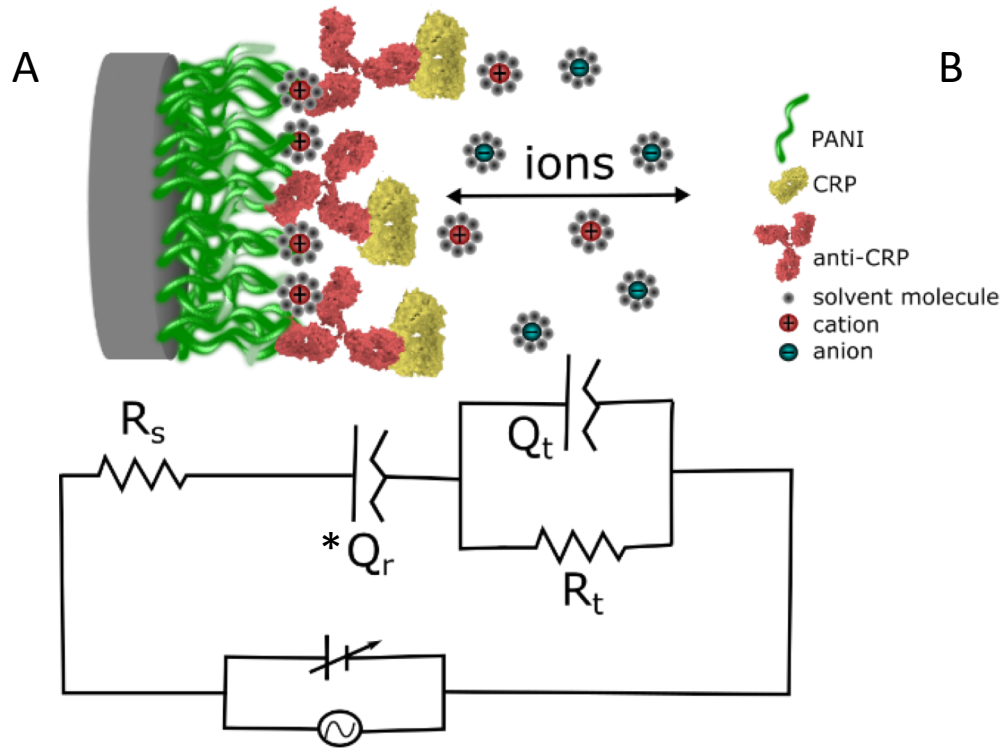
Structure of PANI-PA demonstrating protonation zone between PO_3H_2 and NH_2 groups during electropolymerisation forming homogeneous structure.

Electrochemical detection of antibodies against SARS-CoV-2 Spike protein based on miniaturised platforms



Electrochemical characterization of PANI-PA films after different polymerization times (5–80 min) in 0.1 M PB, pH 7.4. (a) CVs at scan rate of 100 mV s⁻¹. (b) Capacitive Nyquist plots at redox IN potential (-0.16 V), where C_r can be resolved as the diameter of the semicircular region. The inset shows the temporal stability of C_r ; after an initial signal decrease, the baseline is stable within $\leq 2\%$. (c) Measurements at redox out potential.

Electrochemical detection of antibodies against SARS-CoV-2 Spike protein based on miniaturised platforms

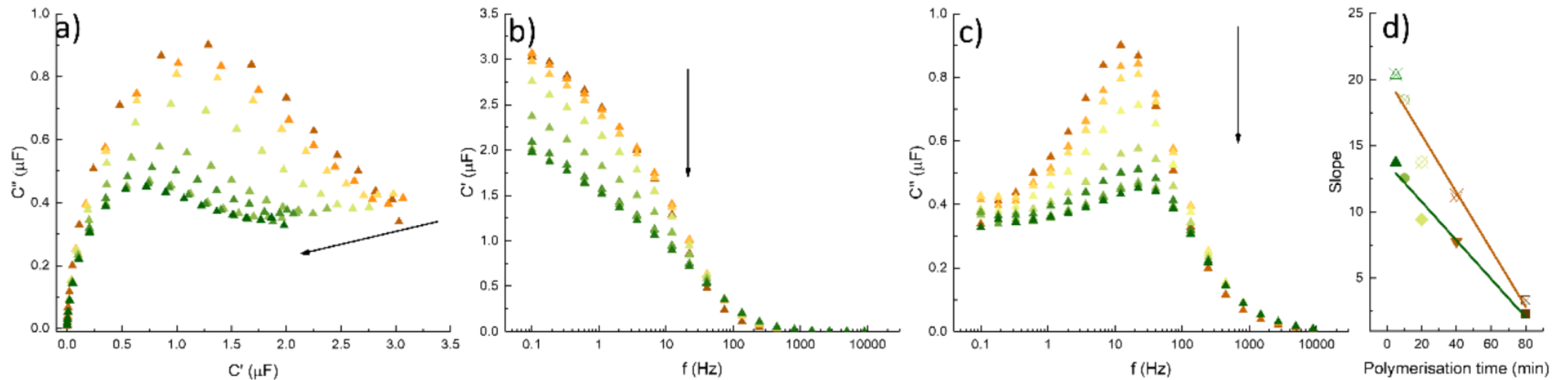
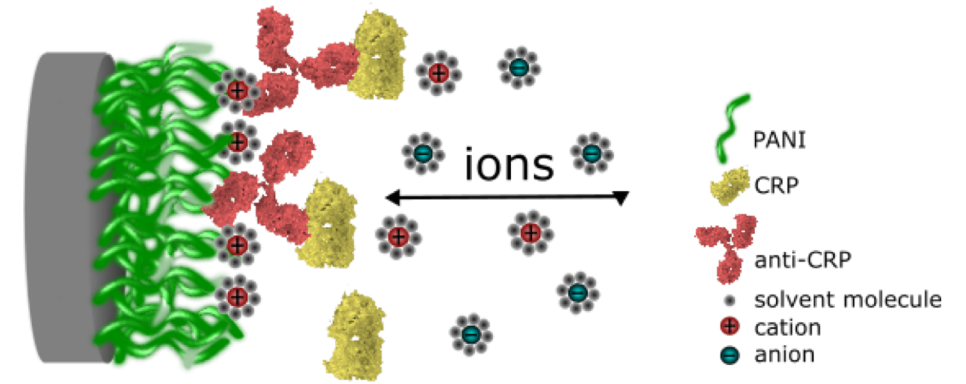


A- Scheme of sensor layers and developed equivalent circuit for quantification of capacitive signal (calculated from Q_r).

B- Capacitive Nyquist plots demonstrating increase of capacitive signal after redox active polymer and decrease after antibody loading;

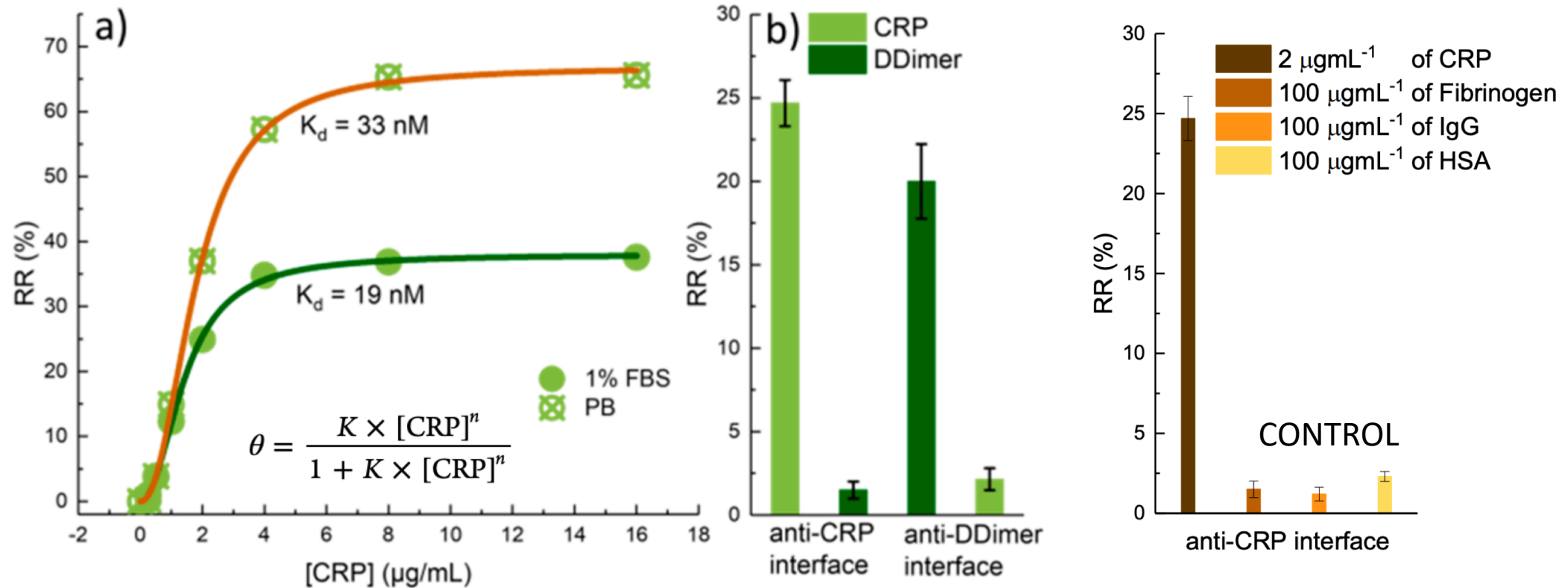
* Q_r - Constant phase element used for non-ideal redox capacitance (C_r).

Electrochemical detection of antibodies against SARS-CoV-2 Spike protein based on miniaturised platforms



Redox capacitive data for anti-CRP/PANI-10min after exposure to increasing concentrations of CRP in 1% FBS. a) Capacitive Cole-Cole plots. b) and c) Bode plots of the real and imaginary capacitance, respectively. d) Slope of the linear region of the calibration curve (sensitivity) as a function of polymerization time.

Electrochemical detection of antibodies against SARS-CoV-2 Spike protein based on miniaturised platforms



(a) Relative response of PANI-10 min/anti-CRP toward CRP in PB and in 1% of FBS in clinically relevant range. The data was fitted to a Langmuir–Freundlich isotherm. (b) Relative response of anti-CRP or anti-D-dimer-modified PANI-10 min after exposure to 2 µg/mL of CRP or D-dimer in 1% FBS. Error bars represent one standard deviation from independent measurements on different electrodes.

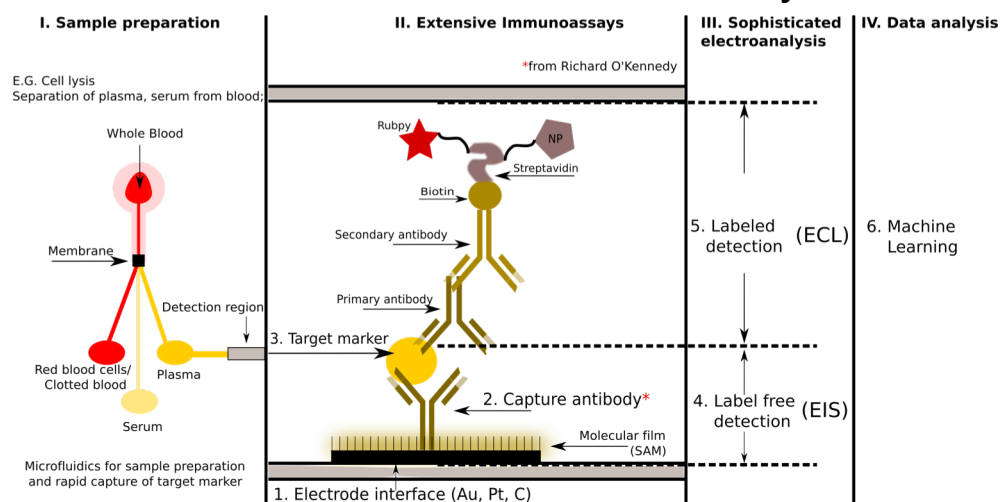
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