Nanobody-based electrochemical biosensor platform for rapid detection of aerosolized pathogens

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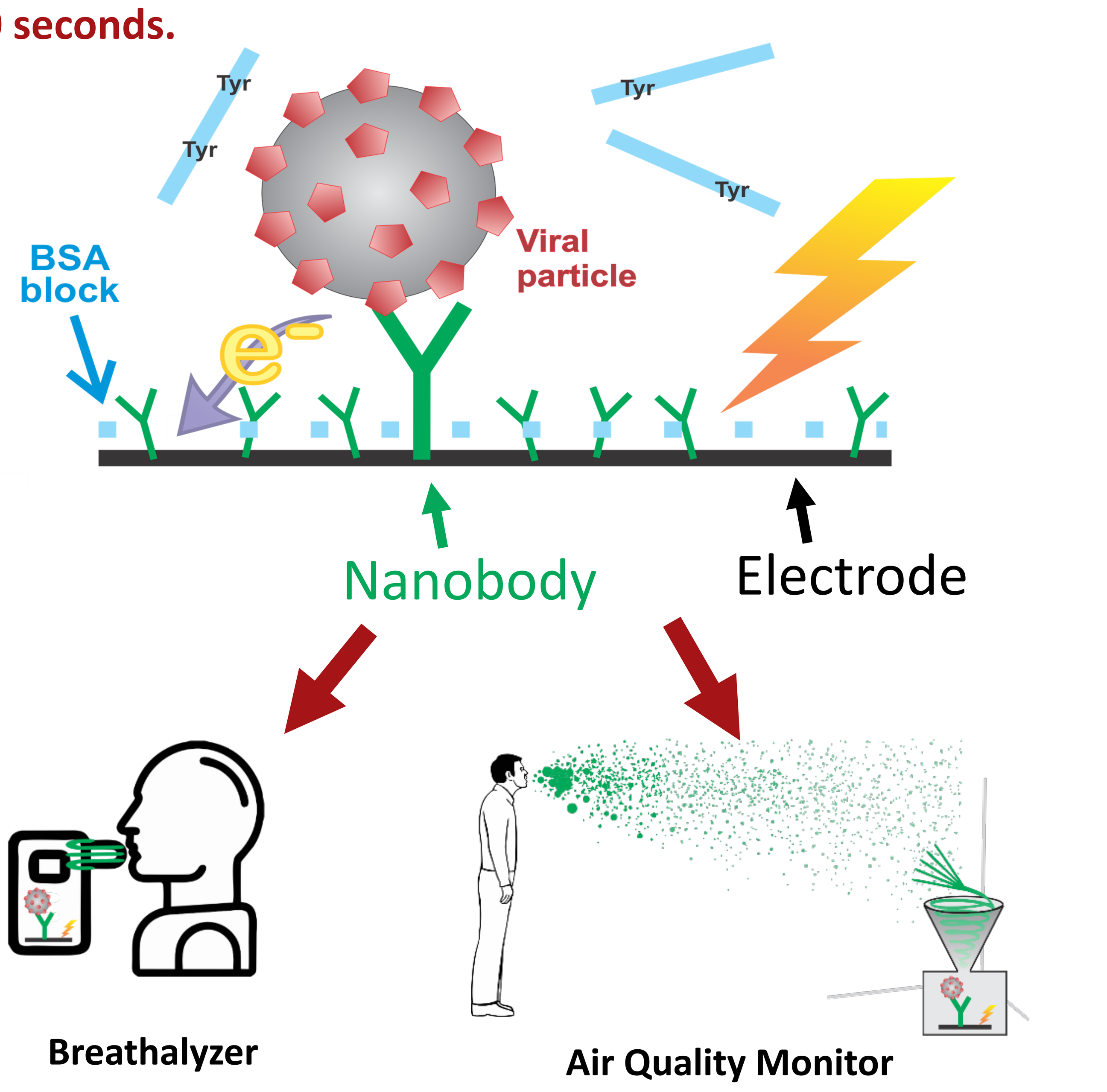
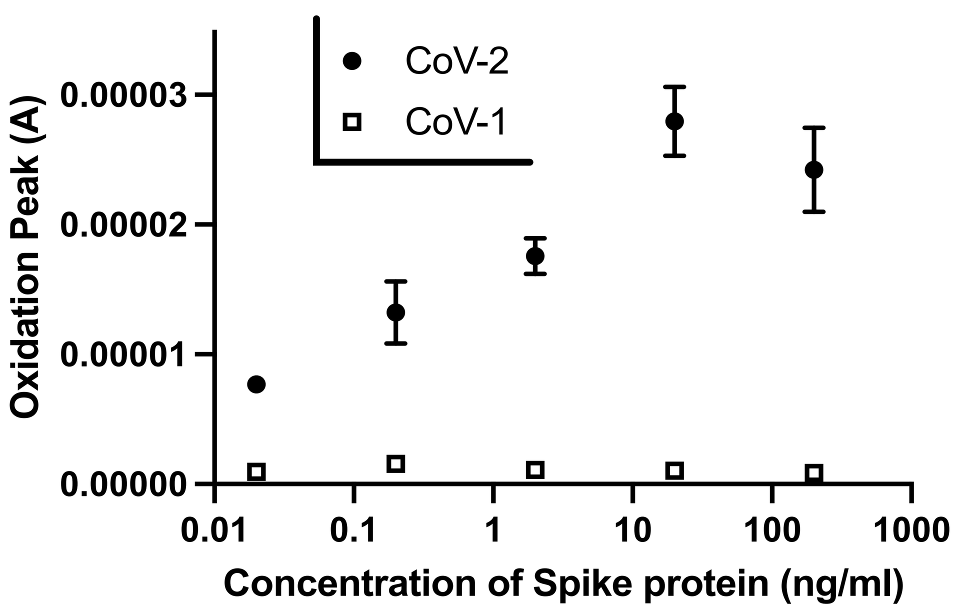
Electrochemical biosensor to detect pathogens (viruses, bacteria, fungi, etc)

A nanobody, raised in llamas, is covalently bound to the working electrode to concentrate the target pathogen near the surface. The electrode uses square wave voltammetry to measure oxidation of tyrosine amino acids. When pulsed with a voltage, tyrosine amino acids within the entire viral particle are oxidized which releases electrons that the electrode detects as current. The amount of current is proportional to the amount of target bound to the surface. The electrode is coated with albumin to block non-specific signal. **Each measurement takes under 20 seconds with instant readout.**

The biosensor is being deployed in an air quality monitor for indoor detection of airborne pathogens in real-time and a breathalyzer for differential diagnosis of respiratory illness in 60 seconds.



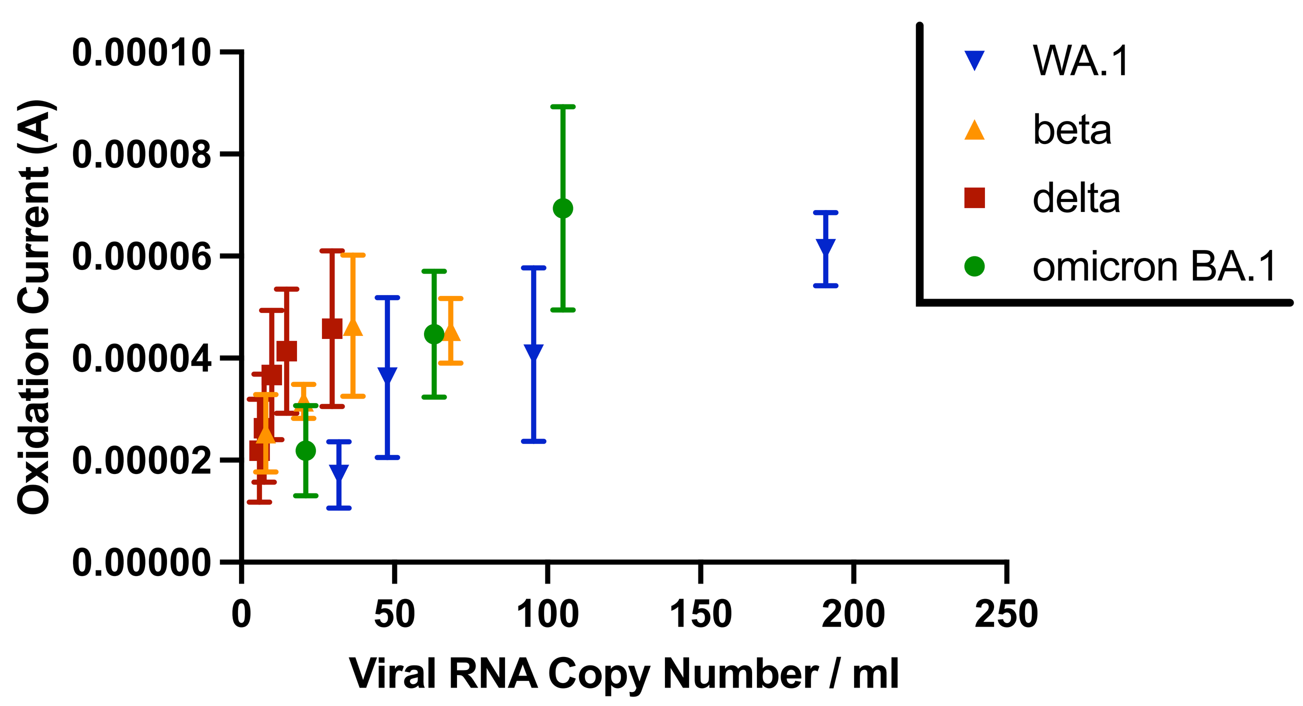
The biosensor is selective for CoV-2 versus CoV-1 spike protein



Ultra-sensitivity of the SARS-CoV-2 biosensor

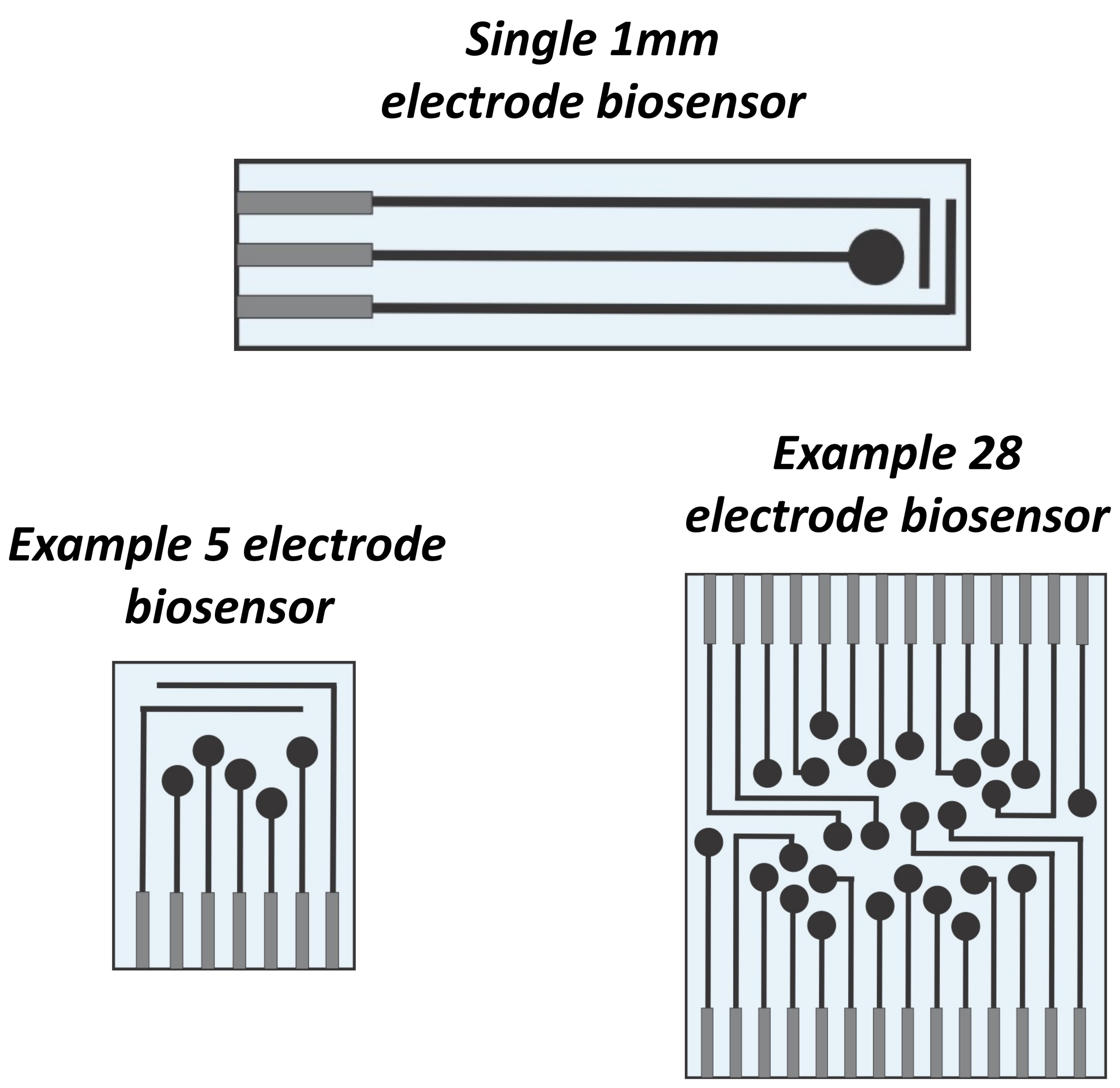
A dilution series of inactivated SARS-CoV-2 viral particles of various strains was applied to the biosensor. **The biosensor is sensitive to 10's of viral particles per sample.**

A clinical study run at the Washington University Infectious Disease Clinical Research Unit (IDCRU) demonstrates the biosensor detects live virus as well as the most recent strains circulating in the community.

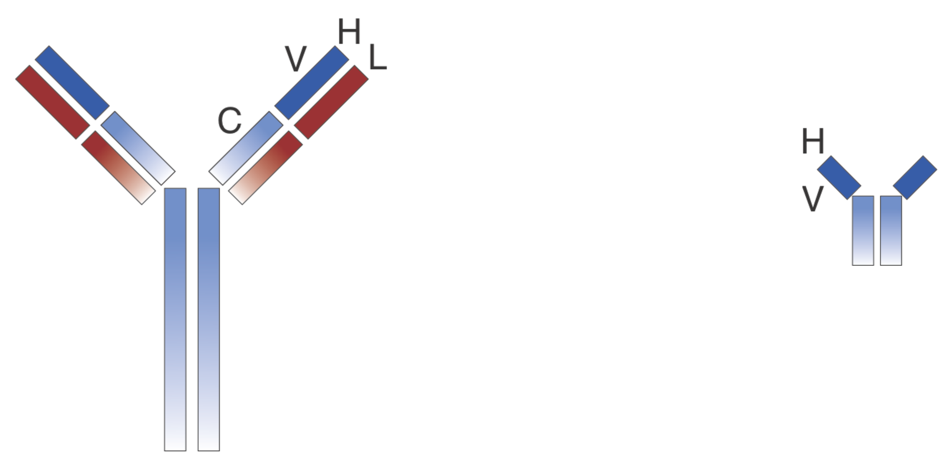


Note: A deep breath contains 200-600 CoV-2 viral particles
(Riediker et al. JAMA 2020; Li et al. Frontiers Medicine 2021).

Multiplexed biosensor for simultaneous detection of numerous pathogens



Canonical IgG Antibody / Camelid Single Domain Nanobody (VHH)



Canonical IgG Antibody

- Expressed by most species
- 160 Kda
- Complex disulfide bonds linking subunits
- Requires immunization and screening for each antigen

Camelid Single Domain Nanobody (VHH)

- Expressed by camelids (camels, alpacas, llamas, guanacas)
- 15 Kda
- Simple, consistent structures
- Can immunize or generate naïve library
- Grown in bacteria inexpensively
- Naïve library enables rapid panning for new lead nanobodies

Biological and geographical diversity to maximize nanobody library recognition elements

We are in the process of generating a naïve nanobody library with 10^{12} distinct specificities to rapidly screen for nanobodies against new pathogens.

Typical nanobody libraries have 10^{7} specificities. We will increase that by several orders of magnitude by sampling nanobodies from all **4 camelid species** as well as from **4 different geographical locations**. The combination of biological and geographical diversity maximizes the utility of the naïve library to screen for new pathogens rapidly. The library enables us to **develop new biosensors against known and emerging pathogens within 2 weeks.**

Acknowledgements:

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Y2X Life Sciences has an exclusive option to license the device technology and consulted during design stages of the device to facilitate commercialization.