# Lab-on-Chip for Dengue Virus detection

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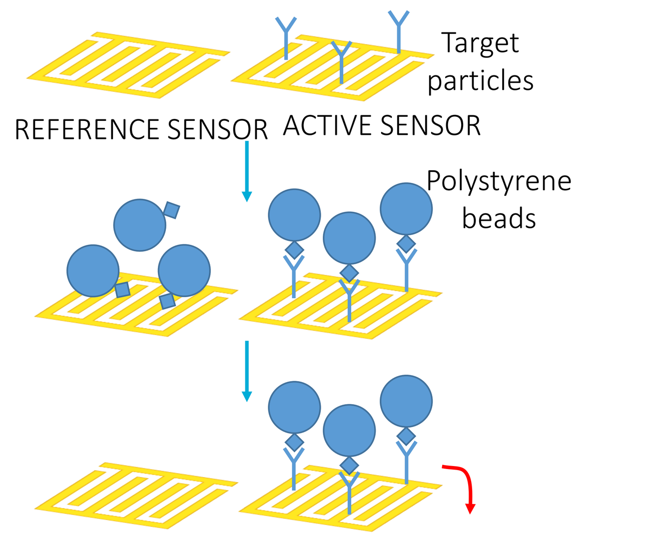
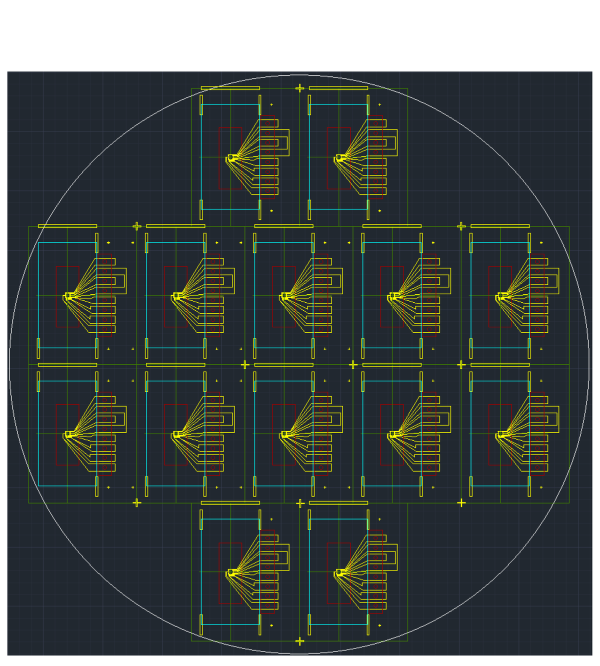
This work is part of **READy** project, a regional scientific network of excellence for the rapid response to bioemergencies developing new bio-reagents and diagnostic kits.
Our contribution is on the realization of a device based on Electrochemical Impedance Spectroscopy. The nanometric biological target is linked to a larger structure (polystyrene beads) with easily identifiable electrical properties compared to the surrounding environment (conductive medium). In this way it is possible to detect its presence with a differential impedance measurement of the conductivity properties of the liquid near the electrode detection area and to correlate the electrical variation to the number of particles bound to the surface.

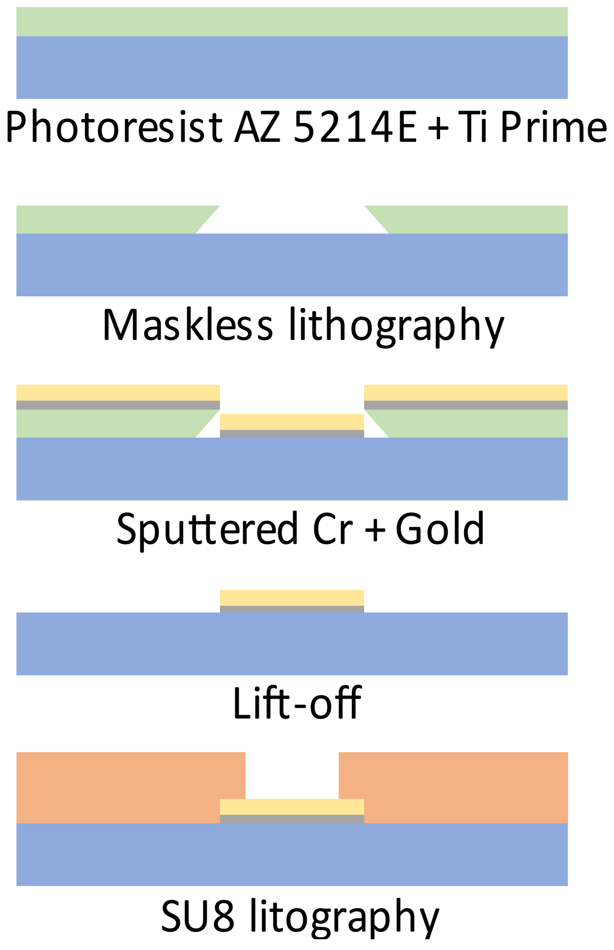


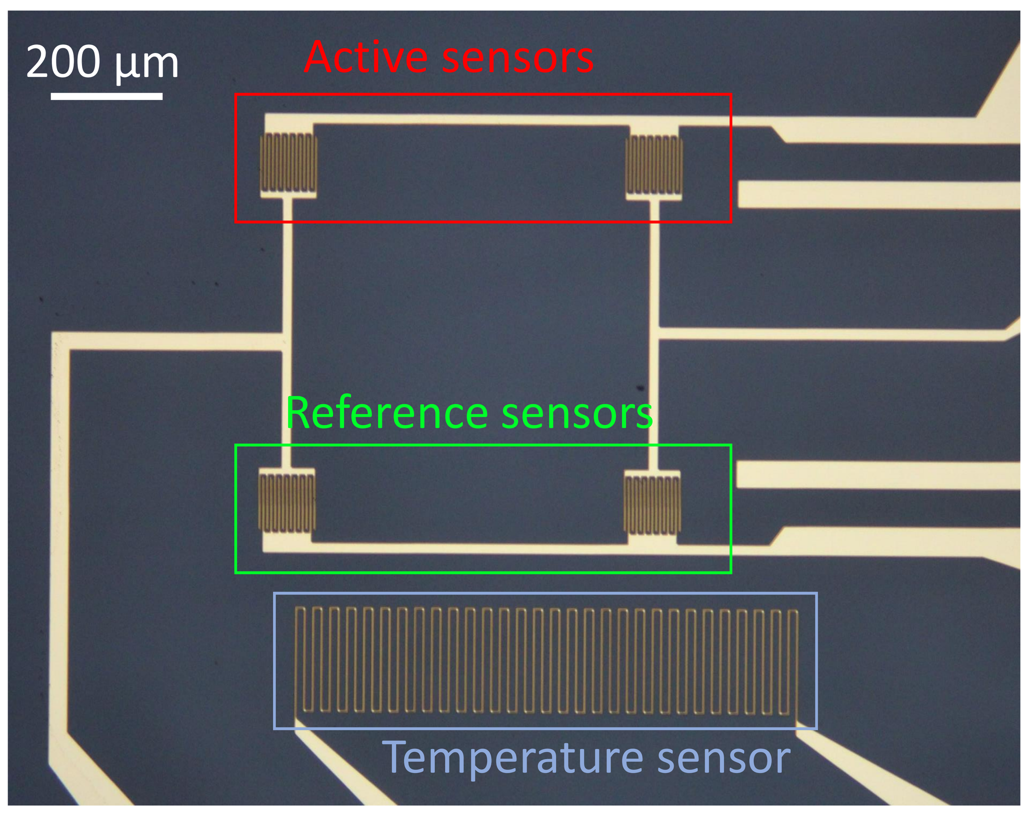

ΔV ∝ n° beads ∝ n° target biological particles

## FABRICATION PROCESS

- **Borosilicate glass** substrate for Signal to Noise Ratio (SNR) maximization
- **Gold interdigitated electrodes** (3 µm bands/gaps)
- **SU8 mask** for parasitic capacitance minimization
- **Differential configuration** for rejection of common mode disturbances



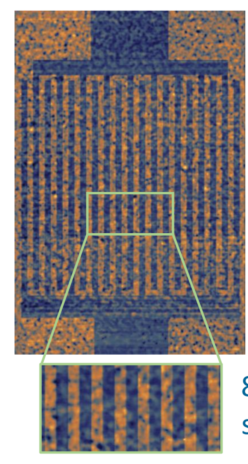


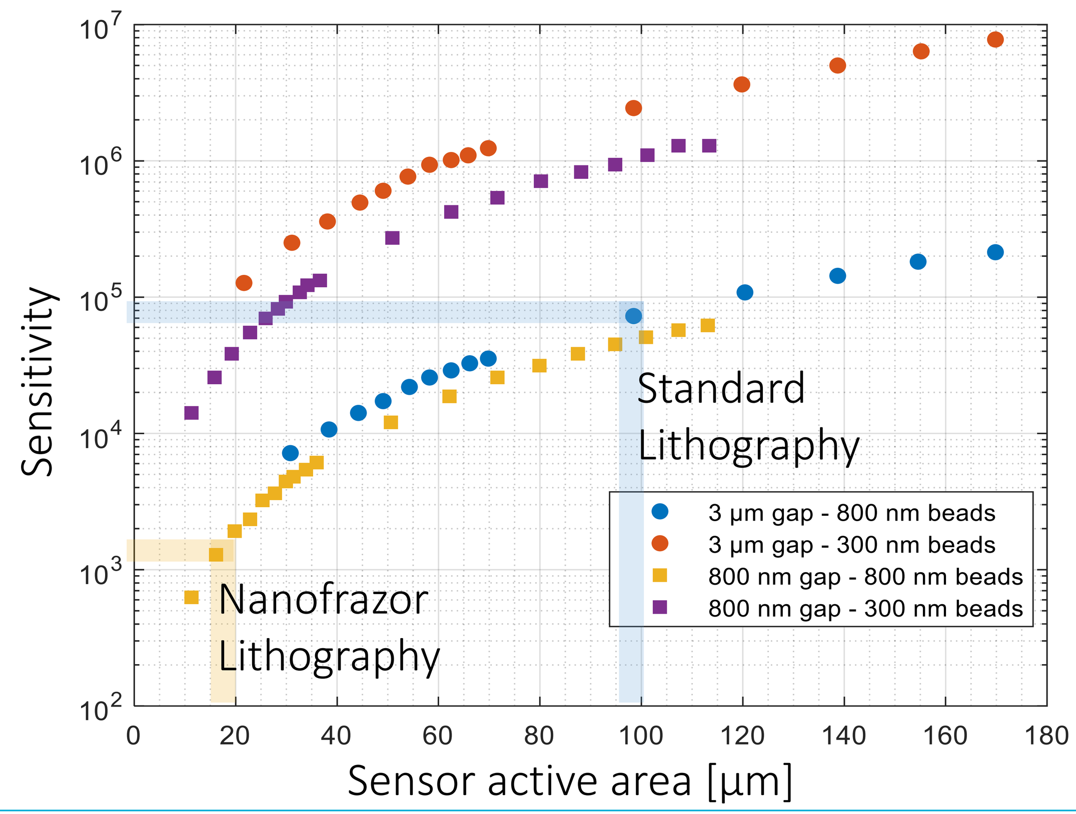




## NanoFrazor Lithography

**IDE scaling with NanoFrazor lithography**

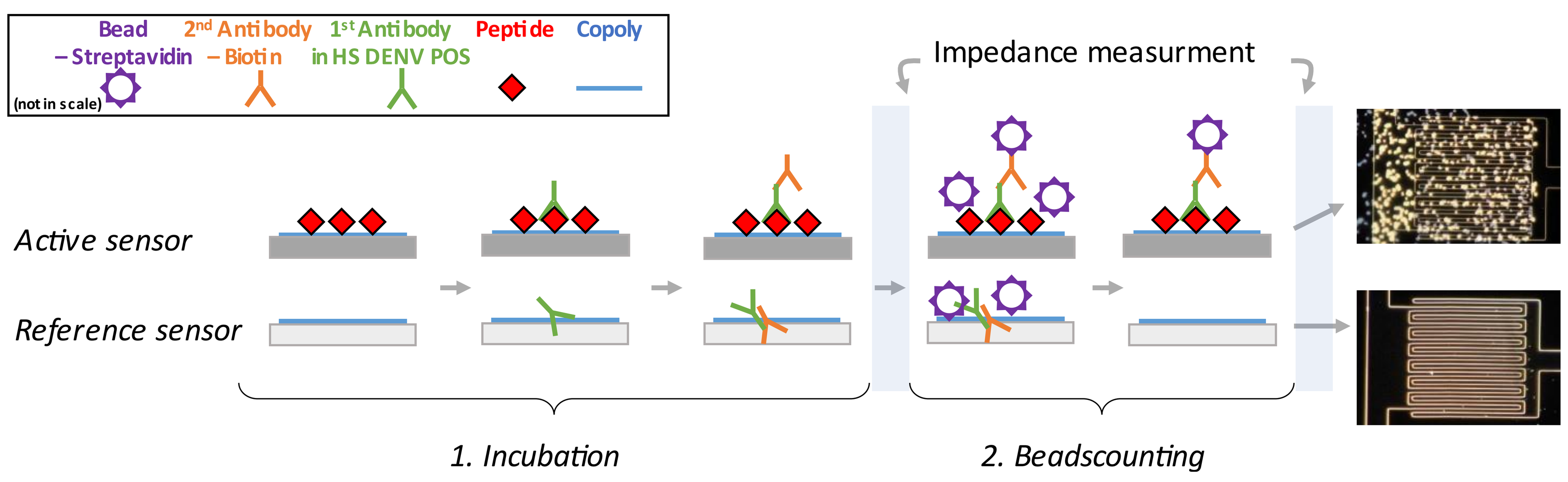
**From COMSOL simulations:** *x100 Sensitivity Enhancement*



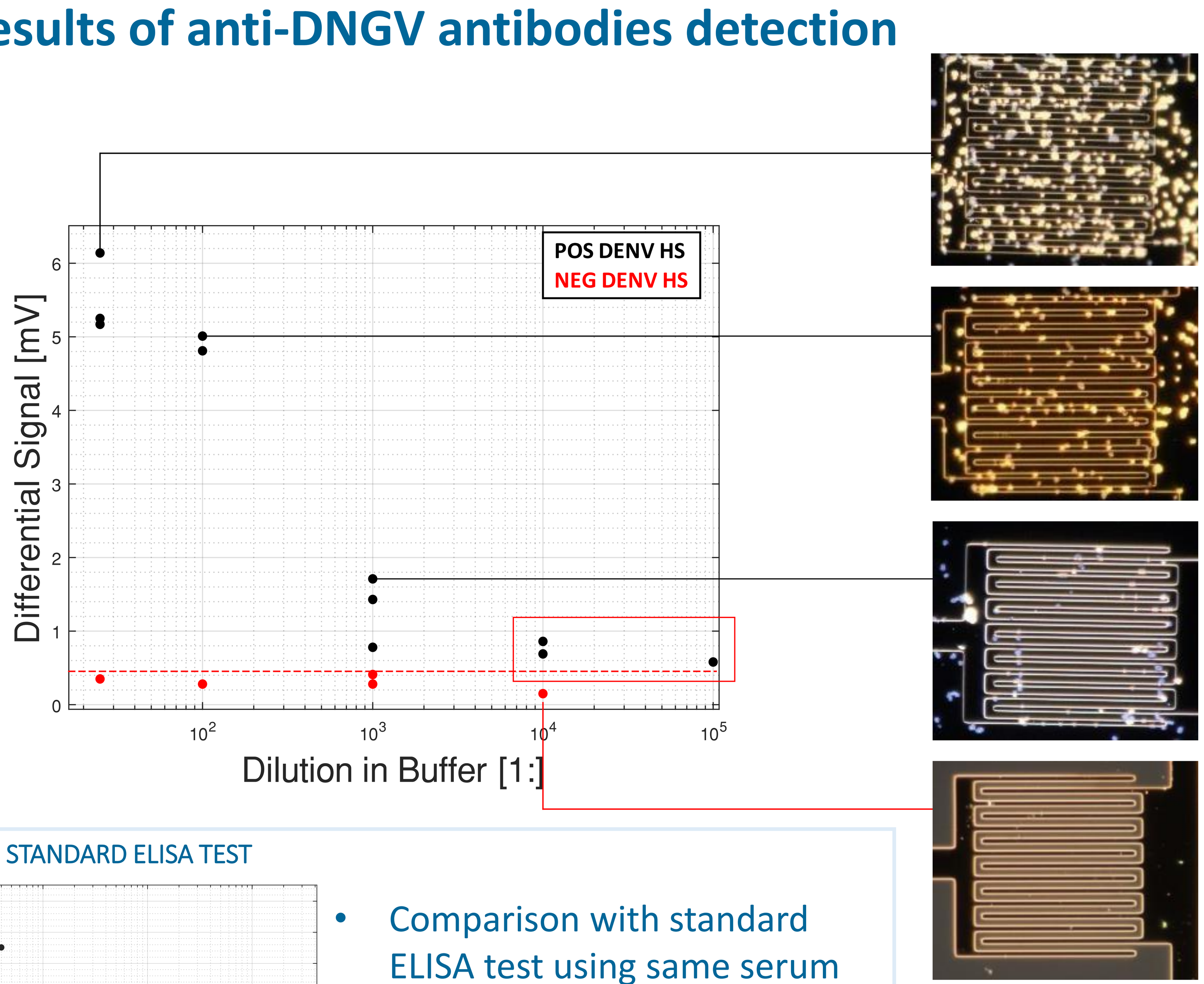



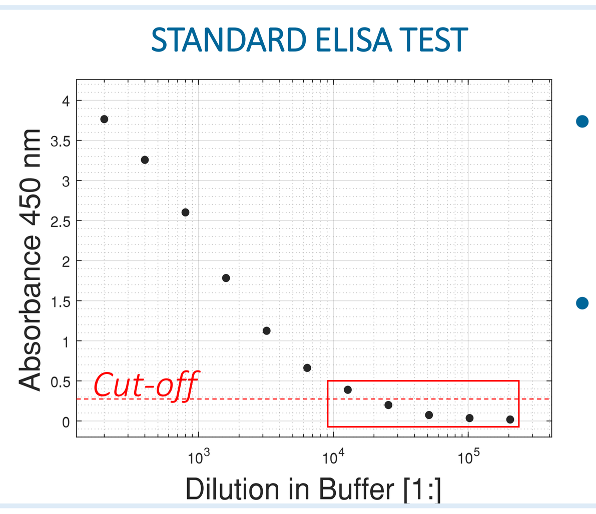

## Limit of Detection of the System and Case study on anti-Dengue Virus antibodies in human serum

### Measurement Protocol



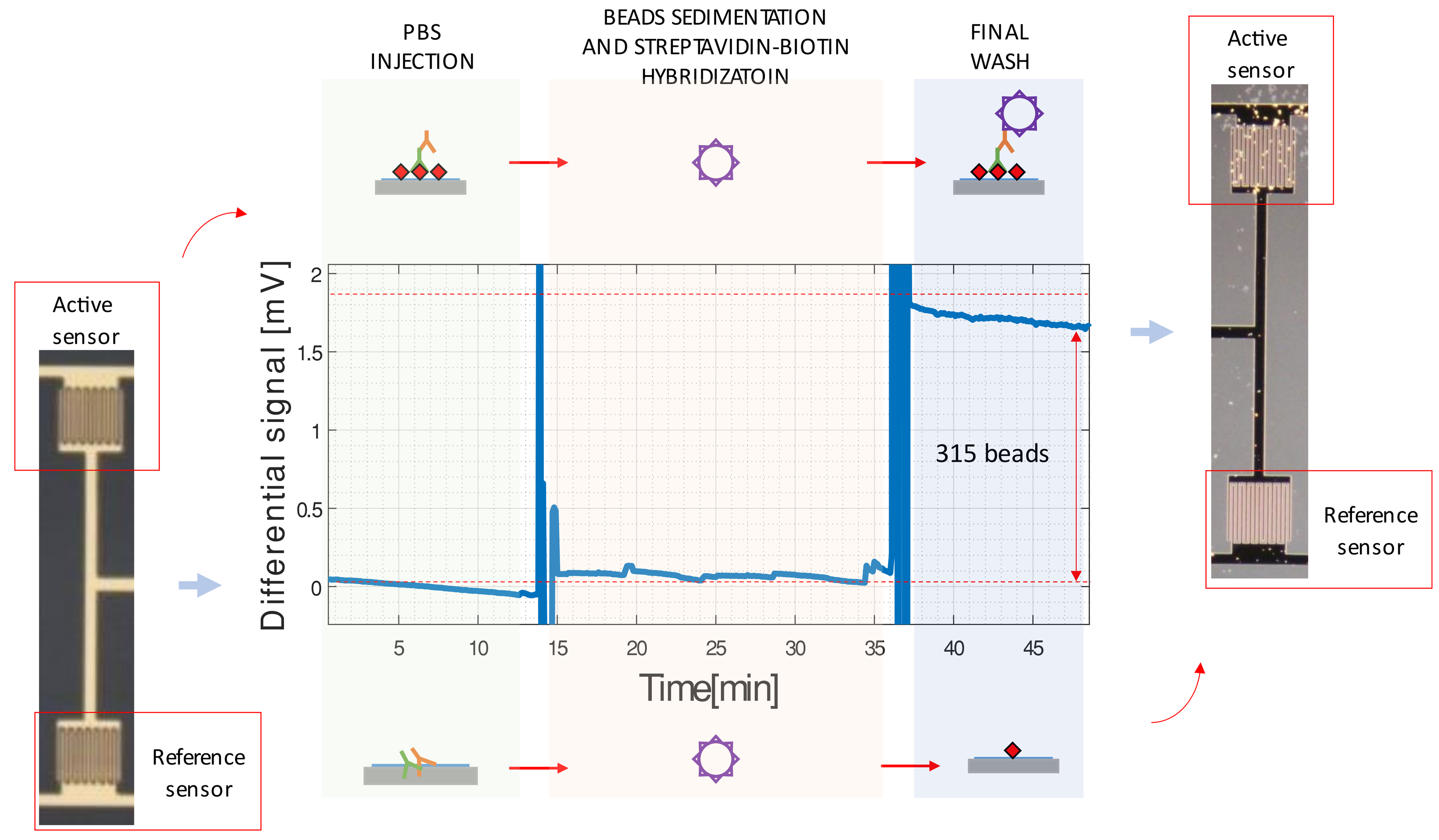

### Results of anti-DNGV antibodies detection

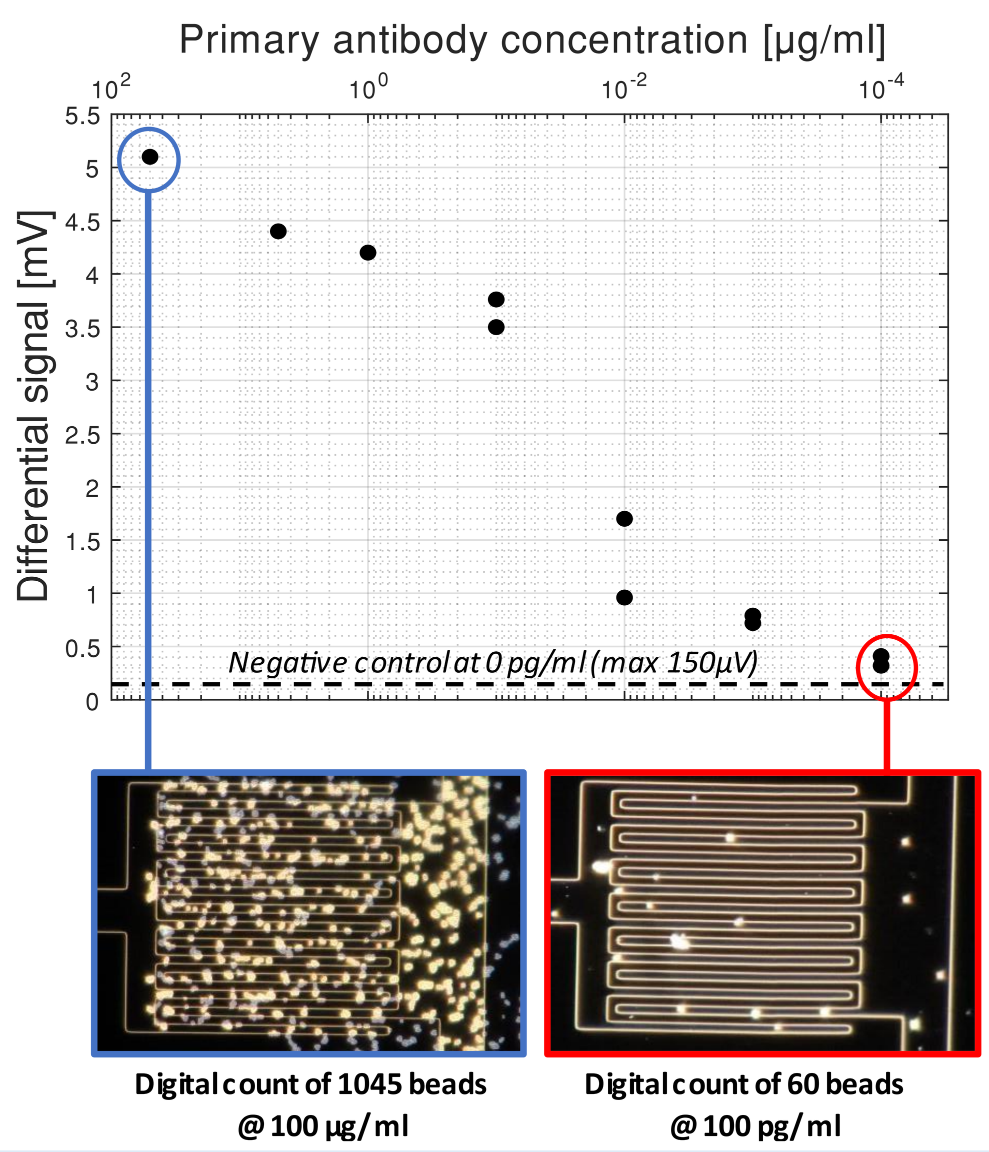



- Comparison with standard ELISA test using same serum samples
- Detectable signal for dilution up to $10^5$ for our sensor (x10 better than the standard test)

### Limit of Detection for commercial IgG antibodies




- **LOD of 100 pg/ml**
- **Negative control** (same protocol with zero concentration of primary antibody) have given a mean value of (120 ± 30) µV
- **Single bead** produces a signal of **5 µV** (from 4 µV if placed over the electrode to 6 µV if situated within the IDE gap)

## References

[1] Darwish, N.T., et al., *Point-of-care tests: A review of advances in the emerging diagnostic tools for dengue virus infection.* Sensors Actuators, B Chem. 255, 3316–3331. (2018)
[2] Carminati M., et al., *Accuracy and resolution limits in quartz and silicon substrates with microelectrodes for electrochemical biosensors,* Sensors and Actuators B: Chemical 174, 168-175 (2012).

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