9th International Conference on Molecular Electronics
Paris, France
December, 17-21st 2018

Single Molecule Detection of Markers with a Label Free Bio Electronic Sensor

Eleonora Macchia,[1] Kyriaki Manoli,[1] Brigitte Holzer,[1] Cinzia Di Franco,[2] Matteo Ghittorelli,[3] Fabrizio Torricelli,[3] Domenico Alberga,[4] Giuseppe Felice Mangiatordi,[4] Gerardo Palazzo,[1,6] Gaetano Scamarcio,[2,5] and Luisa Torsi[1,6,,7]

[1]Dipartimento di Chimica - Università degli Studi di Bari "Aldo Moro" - Bari (I)
[2]CNR - Istituto di Fotonica e Nanotecnologie, Sede di Bari (I)
[3]Dipartimento Ingegneria dell'Informazione - Università degli Studi di Brescia - Brescia (I)
[4]Dipartimento di Farmacia - Scienze del Farmaco - Università degli Studi di Bari "Aldo Moro" - Bari (I)
[5]Dipartimento di Fisica "M. Merlin" - Università degli Studi di Bari – "Aldo Moro" - Bari (I)
[6]CSGI (Centre for Colloid and Surface Science) – Bari (I)
[7]The Faculty of Science and Engineering - Åbo Akademi University – Turku (FI)

Label-free single-molecule detection has been achieved so far by funnelling a large number of ligands into a sequence of single-binding events with few recognition elements host on nanometric transducers. Such approaches are inherently unable to sense a cue in a bulk milieu. Conceptualizing cells' ability to sense at the physical limit by means of highly-packed recognition elements, a millimetric sized field-effect-transistor is used to detect a single molecule. To this end, the gate is bio-functionalized with a self-assembled-monolayer of trillions of capturing anti-Immunoglobulin-G and is endowed with a hydrogen-bonding network enabling cooperative-interactions. The selective and label-free single-molecule IgG detection is strikingly demonstrated in diluted saliva while 15 IgGs are assayed in whole serum. The suggested sensing mechanism triggered by the affinity binding event, involves a work-function change that is assumed to propagate in the gating-field through the electrostatic hydrogen-bonding network. The proposed immunoassay platform is general and can revolutionize the current approach to protein detection.

E. Macchia, K. Manoli, B. Holzer, C. Di Franco, M. Ghittorelli, F. Torricelli, D. Alberga, G.F. Mangiatordi, G. Palazzo, G. Scamarcio and L. Torsi, *Nature Communications,* **volume 9**, Article number: 3223 (2018).
Highlighted in Nature: https://www.nature.com/articles/d41586-018-05950-z