Graphene nanodevices for biochemical detections: from neural spike to ion channel detection within living cells.

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Several types of electronic devices have been developed to detect ions and electrical signals through cell membranes. In the 1950's, patch-clamp was a pioneer method to record either spiking activity (e.g. neural cells) or ion channel currents. Then, because they are easily interfaced with cells, microelectrodes (MEs) appeared as robust and less damaging method to follow neural activity. But these devices are still limited in term of electrical sensitivity and spatial resolution. Over the past decade, this sensitivity was enhanced by developing field-effect detection. Indeed, field-effect transistors (FETs) allow to reach higher electrical sensitivity while reducing the channel length. Meanwhile, bioelectronics sensing has been also improved by using graphene to design microelectrodes or FET channels. Because of their high sensitivity and chemical stability in liquid media, the graphene FETs, we have developed, are an ideal platform for biomolecular and ion sensing. These devices are used to detect analyte composition[1] or pH[2] changes, proteins activity such as ion channels[3] and electrical signals within electrogenic cell[4][5]. Here we show our recent works about (1) hybrid biosensors to transduce biological signals from Xenopus oocytes with ultra-high sensitivity down to individual ion channels and (2) on real-time opto-electrical recordings within neuron network that open avenue of investigations for sensing living matters and ionic fluids in general.

References

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Figures

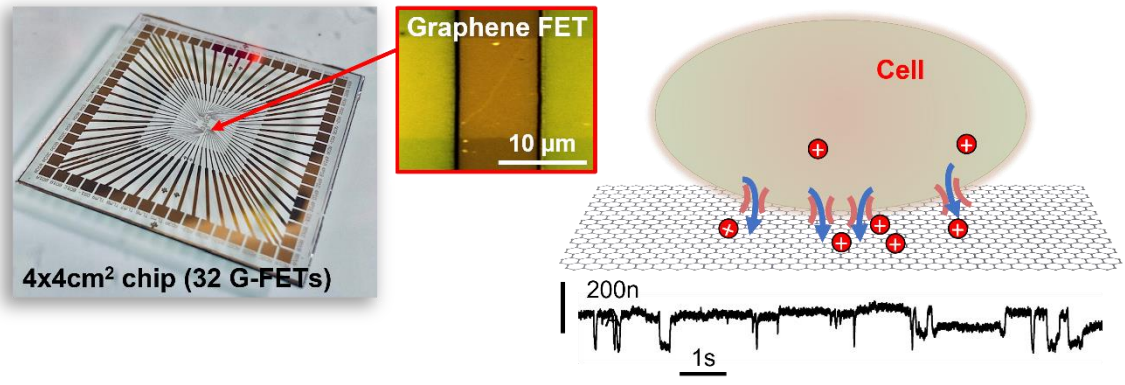

Figure: Graphene-FET detection of ion channel activity at the cell interface