Fabio Biscarini

CNR-ISMN Bologna, Italy

ORGANIC FIELD EFFECT TRANSISTORS AS TRANSDUCERS OF SYNCRONIZED SIGNALS FROM NEURONAL CELL POPULATION

Label-free transduction of signals exchanged in a neuronal cell population in response to a specific chemical stimulation is demonstrated with human SH-SY5Y neuroblastoma cells *in vitro* by using a dual-gate polymer field-effect transistor. The neural signaling is triggered with a neurotransmitter, dopamine, then inhibited with γ-aminobutyric acid (GABA). The nA-level noise on the transistor current base line exhibits time-correlated fluctuations dependent on the chemical stimulus, with periodic features resembling firing, burst, hyperpolarization and depolarization events. The timescales (tens of seconds), longer than those observed in experiments with individual cells (ms) and neuronal networks (1-10 s), reflect the synchronization of the whole population. The analysis of the power spectral density of the noise generated by the cells reveals that i) the envelope enclosing the smeared resonances decays as $1/f^2$ at higher frequency f; in the absence of cells it decays as $1/f^{0.5\div1.5}$; ii) the resonances in the cell noise triggered by dopamine and GABA are harmonics of two fundamental frequencies which scale as the respective diffusion coefficients. This evidence hints that the syncronization of the SH-SY5Y population occurs by the diffusion of paracrine signals.

The noise from a neuronal cell population obtained by differentiation of murine stem cells can be also recorded using an ultra-thin film pentacene transistors (thickness 6 monolayers) gated with an electrolyte, in this case the aqueous medium. We discuss the transduction of the collective response to pulsed electric fields applied with the device. This work is supported by EU NMP Project I-ONE Grant Agreement n. 280772.