October 28, 2009

The Interfacing of Semiconductor Chips with Ion Channels, Nerve Cells and Brain

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ABSTRACT OF THE TALK

The lecture addresses ten selected aspects of the electrical interfacing between semiconductor chips and neuronal systems: (I) The nature of signal transduction from ionic current in cells to electronic current in semiconductors and vice versa is considered. (II) The properties of electrolyte-oxide-semiconductor field-effect transistors (EOSFETs) are compared with common MOSFETs. (III) The noise of transistors beneath a cell is used to determine the seal resistance between cell and chip. (IV) A cell-based biosensor is presented with a serotonin receptor on a transistor. (V) A voltage-gated sodium channel is activated by a high k capacitor. (VI) CMOS chips for one-way and two-way interfacing with neuronal systems are presented. (VII) Two-way interfacing of networks is described with neurons from snail and rat. (VIII) The retina from rabbits is stimulated by a high k capacitor. (IX) Space-time maps of neuronal activity in slices from rat brain (hippocampus) are recorded with a CMOS chip. (X) The somatosensoric cortex of living rats is probed with transistors on needle-shaped silicon chips.