CMOS-Based Monolithic Microelectrode Systems for Subcellular-Resolution Electrophysiology and Sensor Applications

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Microelectrode arrays (MEAs) are devices that can be used in biomedical and basic in-vitro research that provide biochemical and extracellular electrophysiological information about biological systems at high spatial and temporal resolution. Complementary metal-oxide-semiconductor (CMOS)-technology is an enabling technology to batch-produce MEAs with thousands of micro-scale electrodes, placed at high spatial density. The complex microsystems feature - on the very same chip - addressing logic and circuitry units for signal conditioning in order to provide excellent signal-to-noise characteristics. Depending on their layout and functionalization, CMOS MEAs can, for example, be used to electrochemically detect certain substances of interest, such as biochemical agents. HD- MEAs without functionalization, which feature a very high spatial density (>3000 electrodes per mm^2) of comparably small electrodes (diameter of 5-7 µm and a center-to-center pitch of 17 µm) can be used for electrophysiological analysis of complete networks of brain cells at cellular or subcellular resolution.