Quartz insulated platinum micro- and nanoelectrodes as a basis for the preparation of pyrolytic carbon electrodes

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A wide working potential window, an exceptional structural and chemical stability and a good resistance to deactivation makes carbon (i.e. graphite, glassy carbon, boron-doped diamond) an attractive electrode material for electrochemical studies in aqueous solutions. Particularly, for in vivo electrochemical analysis in biological tissue carbon electrodes became tools of choice because they are less susceptible to electrode foulding and show a much better long-term stability for the detection of neurotransmitters release in physiological media than novel metal-based electrodes. Fast-scan cyclic voltammetry and amperometry at carbon-fiber microelectrodes (CFMEs) for example are nowadays commonly used to detect neurotransmitter release from individual secretory cells[1]. More recently, constant-distance mode scanning electrochemical microscopy (SECM) employing 7-µm-diameter CFMEs as scanning probes was used to image individual catecholamine-releasing cells[2]. SECM allowed gentle positioning of the CFME tip in proximity to the cell membrane and finally, upon suitable stimulation, local detection of single-vesicle transmitter release at distinct areas of the cell. However, spatial resolution of such kind of measurements is strongly related to the size of the SECM tips and thus carbon electrodes of reduced electrochemically active areas are of high interest..

In this communication we report on a new type of carbon electrode which is prepared by coating the disks of quartz glass-insulated platinum (Pt) microelectrodes with pyrolytic carbon. As proven by scanning electron microscopy (SEM) and cyclic voltammetry (CV), thin and well adhering layers of conductive carbon have been achieved by pyrolysing a polymer which had been electrochemically predeposited onto the microelectrode surface. The potential of the method concerning miniaturization was evaluated by using recently described Pt nanoelectrodes[3] as precursors for the polymer deposition. Furthermore, first applications of the obtained electrodes in shear-force based constant-distance mode SECM imaging will be shown.

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