Diamond Microelectrodes for Probing Neurosignaling Processes in the GI Tract

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Diamond microelectrodes exhibit attractive properties for neuroanalytical measurements, such as a low and stable background current, microstructural stability and carbon corrosion resistance at high potentials, weak molecular adsorption and fouling resistance, and a pH independent background current. Our group has been using diamond microelectrodes for twenty years now to study neuroeffector signaling *in vitro* at the surface of arteries and veins, and in the small and large intestine of animal models and human subjects. In the GI tract, key neurotransmitters of interest include serotonin, nitric oxide, acetylcholine, and ATP. The diamond microelectrodes are prepared by overcoating sharpened Pt wires with a layer of boron-doped nanocrystalline diamond. In this presentation, the growth of diamond on the substrate wires will be reviewed. Additionally, we will show how the diamond microelectrodes can be used to record oxidation currents *in vitro* associated with the release of serotonin (5-HT) from enterochromaffin cells in the epithelium of the human intestinal mucosa stably and reproducibly. Continuous amperometric measurements were made as a function of distance from the tissue surface in human jejunum specimens. Finally, more recent work to use diamond microelectrodes modified with platinum nanoparticles and Nafion to detect nitric oxide (NO) *in vitro* in the mouse colon will be highlighted. Detection figures of merit for NO were a sensitivity of 16.7 ± 2.7 mA M^{-1} cm^{-2} (n=3 electrodes), a detection limit of 0.5 µmol L^{-1} (S/N=3), and an electrode response reproducibility of 2.5 % (RSD). Electrical stimulation and continuous amperometry were used to measure NO release from myenteric ganglia in wild type male and female mice in response to an increasing number of electrical stimuli to study nitrergic signaling in the colon.