Electroanalytical Eavesdropping on Cellular Communications

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Carbon-fiber microelectrochemistry methods afford unique chemical and biophysical insights into cellular secretion of chemical messenger molecules. Using single cell cyclic voltammetry, it is possible to identify the chemical species secreted while amperometry reveals details about chemical messenger concentration, association with other species, cell membrane characteristics, and release kinetics. Herein, these two techniques are exploited for both fundamental and applied studies in cellular communication. Investigation of the fundamental properties of serotonin storage and release from blood platelets, the first real-time measurements of secretion from individual platelets, has revealed granular serotonin concentration, storage mechanism, and secretion driving forces as well as the role of membrane cholesterol in cell function. Additionally, carbon-fiber microelectrochemistry has been employed as a quantitative and direct measure of cell behavior following nanoparticle exposure. Measurements of this type have become critical as nanoparticle exposure increases drastically without sufficient toxicological data. In this work, the chemical messenger secretion behavior of control primary culture mast and chromaffin cells has been compared to cells exposed to noble metal nanoparticles. Detailed analysis of amperometric data facilitates not only an assessment of nanoparticle safety but also reveals the nanoparticle-cell interactions for future nanoparticle design considerations.