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Biochemical Profiling and Biomechanical Characteristics of Extracellular Vesicles on Charged Surfaces

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Extracellular vesicles (EVs) are nanometer-sized particles that are involved in various physiological and pathological processes due to their heterogeneous content and the complex composition of their membrane. These properties make them a model system for therapeutic interventions (such as drug delivery systems) and diagnostics (as potential biomarkers for "liquid biopsy"). To address the heterogeneity of these complex systems, we use an integrated biochemical-biophysical approach, employing different techniques. In this particular, we use force mapping atomic force microscopy (AFM) to assess the morphology and nanomechanical properties, such as stiffness, of biochemically sorted EVs isolated from different sources, including mammalian cell lines, plants and microalgae. Since EVs of similar size can differ in biogenesis and composition, sorting of EV subpopulations can be challenging and the discrimination of contaminants can be crucial for a potential therapeutic application. We use functionalized substrates with different affinities for extracellular vesicles, exploiting both their net surface charge and their specific components. We focus on carefully controlling the functionalization steps, which are crucial for developing Standard Operating Procedures (SOPs) to optimize and, potentially, create reliable, selective biosensors.