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Biomarker Characterization and Development of Functional Soft Materials

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Abstract

Detection and quantification of biomarkers are essential in providing key information of potential hazardous entities or disease states. Analogously, there is increasing interest in miniaturization of technologies suitable for biological assays, environmental monitoring, model systems and other domains, due to need for more efficient analysis processes, sensitivity, possibilities to deploy in point of care settings and reduction of consumables. In the presentation we illustrate application of direct force unbinding for determination of interaction potential of a therapeutic molecule related to treatment of mucus hyperviscosity in patients suffering from Cystic fibrosis. The data show a dose-dependent perturbation of the interaction profiles in the presence of oligoguluronates that are under development as an adjuvant.

In the second main activity summarized in the presentation, we are using molecular design of hydrogels to transform generic responsive hydrogels to bioresponsive ones. Integrated at the end of an optical fiber interferometer supporting determination of changes in the optical lengths within the hydrogels at 2 nanometer resolution, these functional soft materials are attractive in biosensing. Examples of various implemented recognition schemes will be given. In addition, there is transformation from empirical correlations between molecular parameters of the various constituents and the net swelling response to scrutinize the fundamental, cascading processes and their interrelation. Lastly, an example of microfluidic assisted homogeneous gel bead synthesis will be presented. The microfluidic assisted structuring of soft materials yielded homogeneously sized populations of Ca-alginate gel beads in a biocompatible process supporting immobilization of living entities. The process is based on decoupling of the droplet generation of pregel solution in the microfluidic device and the Ca-induced crosslinking process. A novel strategy for controlling the kinetics of the gelation kinetics of internal Ca-source for the alginate gelation was developed. The micro devices thus support encapsulation of cells in alginate microbeads and fibers in a clog-free and cell friendly microfluidic operation.