

Microfluidics-based fabrication of functional polymeric materials and biological applications

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Hydrogels (3D porous networks) have been successfully proven for a wide range of applications including biosensing because of excellent features: broad selection of precursors and additives, low toxicity, ease of fabrication, and biological compatibility. Dr. Hwang has developed many microfabrication techniques to create various functional hydrogels by precisely controlling their physical properties such as shape, size, microstructure, pattern, and surface morphology. Also, Dr. Hwang has developed microfluidic platforms utilizing such functional hydrogels for various applications such as biomolecule detection and particle/cell trapping. These functional hydrogels and platforms show unique properties and functions which lead to better performance when compared to the existing platforms and hydrogels. For instance, Dr. Hwang's hydrogel membrane-integrated microfluidic platform offers a crossflow configuration for advective transport of target-proteins, which accelerates the delivery of target biomolecules to binding sites inside the hydrogel network. As a result, it takes under 15 mins, which can be further decreased, to capture target-biotin to all available avidin binding sites in a hydrogel membrane with a low detection limit (LOD) of 10^{-1} pg/mL and an excellent dynamic range of 4 orders of magnitude.