Hybrid microfluidic system for simultaneous isolation and release of circulating tumor cells (CTC) using NIR responsive films.

Abstract

The isolation of diverse sample pf circulating tumor cells (CTC) can be either obtained as active or passive manner. While passive approaches manage cells via channel architectures, intrinsic hydrodynamic forces, and steric hindrances, active methods use external fields like electric, magnetic, acoustic, and optical to push cells for separation. However, processing complex biological materials, such as whole blood with unusual cells, makes separation with a single module microfluidic device difficult. In recent years, hybrid microfluidics devices with both passive and active components have gained popularity as a method for label-free enrichment of circulating tumor cells due to their many advantages, such as high sensitivity and high efficiency multi-target cell processing. The goal of this study was to create a near-infrared (NIR) light-responsive substrate by combining a thermos-responsive film with a microchannel of varying lengths in order to accomplish extremely efficient targeted capture and biocompatible site-release of CTCs. Pre-synthesized photothermal agents such as of gold nanorods (GNRs) and gold nanostars (GNSs) were integrated into biodegradable. Later, nano-film was fixed to chip. To improve capture efficiency receptors molecule folic acid (FA) for cancer cells were adsorbed using a straightforward dipping technique respectively for GNR Film and GNSs Film. Temperature-responsive film quickly changes its conformation upon NIR irradiation at 37°C or higher, enabling either site-specific release of individual CTCs through NIR-mediated photothermal activation of embedded GNRs and GNSs, or bulk recovery of trapped CTCs at physiological temperature. This hybrid microfluidic NIR-responsive platform not only provides a robust and flexible route toward tailored anticancer therapies, but it also excels in the collection and site-release of CTCs with excellent survivability.

Key Words- hybrid microfluidics, Nano film, CTC, gold nanorods(GNRs), Gold nanostars (GNSs), Near infrared irradiation(NIR).