Microfluidic Device for Capture and Release of Rare Cells

Technology #6590

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This technology describes a new microfluidic device which utilizes a blend film of graphene oxide (GO) sheets and thermally responsive polymers to enable efficient cell capture and release, including circulating tumor cells (CTCs). Current microfluidics-based CTC isolation technologies are capable of isolating, enumerating and characterizing CTCs, however, CTC release after selective capturing has not been achieved. Existing devices have difficulty releasing the captured cells due to the conjugation of antibodies to permanent structures within the devices.

CTC Capture and Release

This technology makes use of thermos-responsive polymers which show different solubility behavior below and above a critical temperature, called the lower critical solution temperature (LCST). The cells are captured at temperatures above the LCST when the polymer is insoluble in aqueous solution. Lowering the temperature below the LCST will enable polymer swelling and subsequent release of capture cells. The specific LCST of the polymer used in this technology (18 °C, which is lower than room temperature) prevented the inadvertent polymer swelling or dissolution at room temperature. In addition, this temperature also helps in releasing the cells at temperatures not too harsh for the cells thereby maintaining high cell viability after release. The lower critical solution temperature (LCST) of the polymer is at ~18 °C, which is below room temperature and should allow for easy handling of devices in ambient conditions in laboratories and hospitals. It also helps in releasing the cells at temperatures not too harsh for cells thereby maintaining high cell viability. In addition, the polymers described here are cost-effective to synthesize and mass produce. The GO sheets serve as a carrier for phospholipid-PEG-amine, which is a used for the immobilization of an antibody against the epithelial-cell-adhesion-molecule (EpCAM). A prototypical microfluidics device to detect rare breast cancer cells was built. The device was able to capture and release the breast cancer cells with efficiencies of above 90% for both processes. This technology will be applicable to cancer diagnostics and CTC detection, especially in cancers with a high possibility of metatheses.

Applications

- Diagnosis and prognosis of cancers
- Early detection of circulating tumor cells

Advantages

- Promotes effective cell release that could lead to downstream analysis such as fluorescence in situ hybridization (FISH).
• Cell release occurs in less harsh conditions, maximizing the viability of released cells.
• Consolidation of the advantageous properties of GO-based capture with superior release functionality yields a device that enables the study for clinically interesting cells without shortcomings of past technologies

**Inventors**

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