QUANTITATIVE DETECTION OF CD44-EXPRESSING CANCER CELLS USING LABEL-FREE OPTICAL FIBER BIOSENSORS WITH QUASI-RANDOM INTERFEROMETRY

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Background: Circulating tumor cells (CTCs), key biomarkers in cancer progression and metastasis, hold significant value for early cancer detection as predictive and prognostic indicators. However, detecting and quantifying whole cells remains challenging due to their rarity, with most prior research focusing on protein biomarker detection instead. In this study, we present a quasi- random interferometer-based optical fiber biosensor designed for real-time, label-free, and quantitative detection of cancer cells expressing CD44. The sensor is low-cost, easy to fabricate, and functions as a weak interferometer capable of differentiating cancer cells from normal cells. Its detection mechanism relies on local refractive index variations near the sensor tip, correlated with CD44 expression in a concentration-dependent manner.

Materials and methods: Sensor fabrication and calibration, biofunctionalization of sensors, cell culture, imaging and flow cytometry, and data analysis.

Results: The sensor demonstrated a limit of detection (LoD) of 48.8 cells/mL and a sensitivity of dB/10×.

Conclusion: This approach lays the groundwork for developing microfluidic systems and multiplexed CTC detection, representing an important step toward clinical translation.

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Keywords: Optical fiber biosensor, cancer cells detection, breast cancer, cell biosensing, quasi- random interferometer.