A supersensitive silicon nanowire array biosensor for quantitating tumor marker ctDNA

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Abstract: Cancer has become one of the major diseases threatening human health and life. Circulating tumor DNA (ctDNA) testing, as a practical liquid biopsy technique, is a promising method for cancer diagnosis, targeted therapy and prognosis. Here, for the first time, a field effect transistor (FET) biosensor based on uniformly sized high-response silicon nanowire (SiNW) array was studied for real-time, label-free, super-sensitive detection of *PIK3CA* E542K ctDNA. High-response 120-SiNWs array was fabricated on a (111) silicon-on-insulator (SOI) by the complementary metal oxide semiconductor (CMOS)-compatible microfabrication technology. To detecting ctDNA, we modified the DNA probe on the SiNWs array through silanization. The experimental results demonstrated that the as-fabricated biosensor had significant superiority in ctDNA detection, which achieved ultralow detection limit of 10 aM and had a good linearity under the ctDNA concentration range from 0.1 fM to 100 pM. This biosensor can recognize complementary target ctDNA from one/two/full-base mismatched DNA with high selectivity. Furthermore, the fabricated SiNW-array FET biosensor successfully detected target ctDNA in human serum samples, indicating a good potential in clinical applications in the future.

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