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A fluorescent biosensor based on molybdenum disulfide (MoS_2) nanosheets and protein aptamer for sensitive detection of carcinoembryonic antigen

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Abstract:

Simple, rapid, sensitive detection of tumor biomarker carcinoembryonic antigen (CEA) is of great importance for the screening, diagnosis and prognosis evaluation of various gastroenteric tumor. This paper presents a "turn-on" fluorescent biosensor based on molybdenum disulfide (MoS_2) nanosheets and fluorophore labeled protein aptamer for rapid and sensitive detection of CEA protein. CEA aptamer probe can be adsorbed on the surface of MoS_2 nanosheets in close proximity via van der Waals force, triggering fluorescence resonance energy transfer, and consequently fluorescence signal of aptamer probe was quenched. While in the presence of CEA protein, the fluorescence signal was recovered because aptamer probe could detach from MoS_2 nanosheets with binding-induce conformation change. The concentrations of target CEA protein can be determined by monitoring the turn on signal of fluorescence. The sensing platform was utilized to detect CEA with a broad range of 100 pg/mL-100 ng/mL with the detection limit of 34 pg/mL, and simultaneously exhibited good stability, reproducibility and high selectivity. The aptamer-MoS_2 based fluorescent biosensor may be an ideal mode for protein detection in clinical sample, pesticide detection and environmental monitoring.

Key words: Molybdenum disulfide (MoS_2), Aptamer, Carcinoembryonic Antigen (CEA), Fluorescent biosensor, selectivity.

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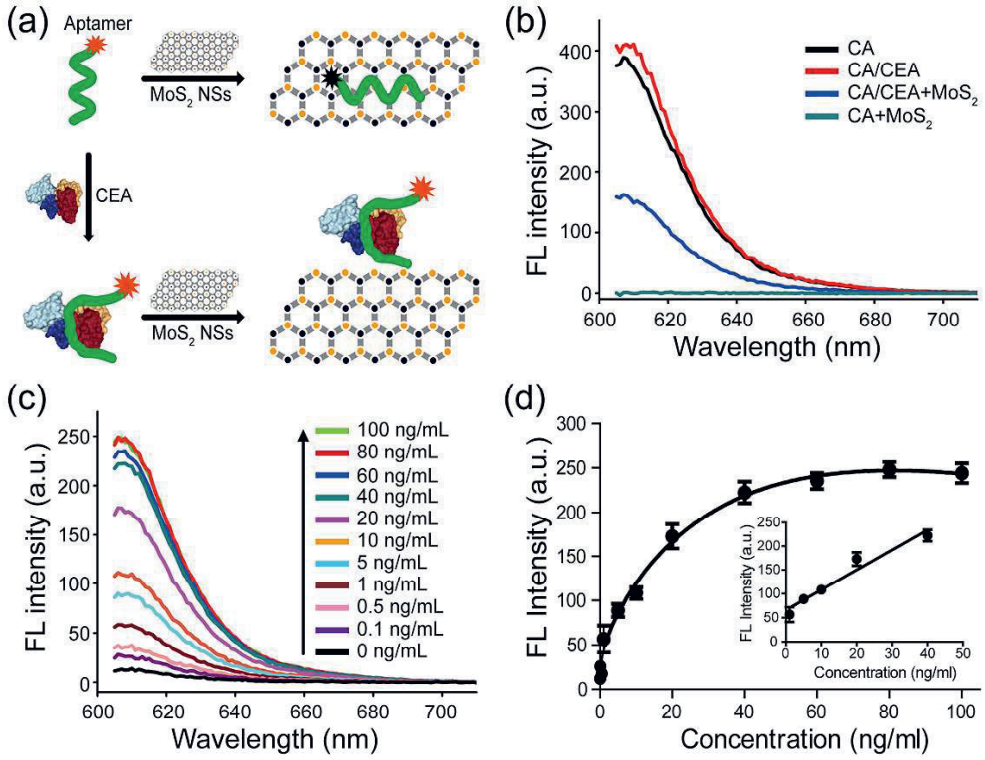

Fig. 1. (a) Schematic illustration of fluorescent biosensor based on MoS2 nanosheets for CEA protein detection; (b) Fluorescence spectra of CA under different conditions; (c) Fluorescence spectra of MoS2-aptamer probe based biosensor in the presence of different concentrations of CEA; (d) The sensitivity analysis of MoS2-aptamer probe based biosensor between different concentrations of CEA and fluorescence signal.