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Revolutionizing Bio sensing: Novel Artificial Antibody Design for Enhanced Detection of Cancer-Specific Antigen

Abstract:

Advancements in prompt and precise detection of analytes are pivotal for augmenting patient survival rates and streamlining medical treatment costs and complexities. Although antibodies are widely employed for functionalizing various nanomaterials in bio sensing platforms due to their excellent selectivity and binding affinity, their intricate structure and thermodynamic instability have impeded their utility in real-time bio sensing. This study introduces a groundbreaking approach by crafting an artificial antibody (AA) through a synergistic blend of supramolecular self-assembly involving a heterodimeric, anti-parallel coiled-coil protein and a single-chain variable fragment (scFv). By substituting the Fc region of conventional antibodies with a heterodimeric coiled-coil protein, we have substantially bolstered the thermodynamic stability and flexibility of the antibody construct. Our meticulous antibody fragmentation scheme plays a pivotal role in regulating its orientation onto a graphene-based field-effect transistor (GFET) sensor, thereby not only enhancing sensitivity but also enabling reusability. The AA-based G-FET device undergoes rigorous testing for the sensitive and specific detection of cancer-specific antigens such as CEA (carcinoembryonic antigen), a secreted protein observed in NSCLC (non-small cell lung cancer) patients. Achieving detection sensitivity for CEA at a remarkably low concentration of ~ 0.2 pM through the innovation of this novel antibody engineering strategy holds immense promise for elevating diagnostic capabilities. Furthermore, the anticipated reusability of our proposed device bears potential for revolutionizing healthcare management practices.

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Biography

With a Ph.D. in Chemical and Protein Engineering from SungKyunKwan University, South Korea, I specialize in Protein Engineering for biosensors, drug delivery, and wound healing. My research focuses on developing cutting-edge biosensor technologies for protein and DNA mutation detection. As a Researcher at Sungkyunkwan University, South Korea and an Assistant Professor at the University of Engineering and Technology, Pakistan, I bring over 14 years of experience in academia and industry, excelling in teaching, research project management, and interdisciplinary collaboration. Passionate about scientific innovation and education, I aim to continue pushing the boundaries of knowledge in my field.

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