Three-dimensional simple bioassay based on fluorescence quenching of macroporous silicon

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We synthesized 3D macroporous silicon through a simple electrochemical dissolution process. Compared with conventional 2D polystyrene plate, the macroporous silicon showed a superior protein adsorption capacity and significant fluorescence quenching effect. We developed a 3D macroporous silicon-based adenosine assay system. In the absence of adenosine, the aptamer-CTMR complexes remain closely attached to the surface of porous silicon, hence fluorescence being significantly quenched. Upon binding to adenosine, the DNA aptamer is subject to structure switching that leads to dissociation of CTMR from DNA aptamer, and consequently the CTMR fluorescence is restored, indicating a simple one-step assay of adenosine. Compared to the conventional 2D PS and ZnO nanorods-based assays, adenosine at much lower (sub-micromolar) concentration was successfully detected through the 3D macroporous silicon-based assay. The three-dimensionally and densely immobilized aptamer probes and effective fluorescence quenching on the surface of macroporous silicon enables adenosine to be detected at lower levels. This simple one-step assay platform can be applied in general to fluorescence quenching -based bioassay.