Effects of diamond-FET-based RNA aptamer sensing for detection of real sample of HIV-1 Tat protein

Abstract

Diamond is a promising material for merging solid-state and biological systems owing to its chemical stability, low background current, wide potential window and biocompatibility. The effects of surface charge density on human immunodeficiency virus type 1 Trans-activator transcription (HIV-1 Tat) protein binding have been investigated on a diamond field-effect transistor (FET) using ribonucleic acid (RNA) aptamers as a sensing element on a solid surface. A change in the gate potential of 91.6. mV was observed, whereby a shift in the negative direction was observed at a source-drain current of -8. μA in the presence of HIV-1 Tat protein bound to the RNA aptamers. Moreover, the reversible change in gate potential caused by the binding and regeneration cycles was very stable throughout cyclical detections. The stable immobilization is achieved via RNA aptamers covalently bonded to the carboxyl-terminated terephtalic acids on amine sites, thereby increasing the sensitivity of the HIV-1 Tat protein sensor. The reliable use of a real sample of HIV-1 Tat protein by an aptamer-FET was demonstrated for the first time, which showed the potential of diamond biointerfaces in clinical biosensor applications.