Picomolar detection limit on a magnetoresistive biochip after optimization of a thiol-gold based surface chemistry.

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Abstract: The surface biochemistry plays a crucial role in the development of stable and reproducible bioanalytical devices. Very often, it represents the bottleneck of a successful integration of magnetoelectronic transducers with the biological receptors on its interface. Here is discussed how a thiolgold surface chemistry can be tailored and optimized in order to allow the biofunctionalization of a magnetoresistive biochip, preventing loss of viability by corrosion while improving its sensitivity. Two important parameters, type of buffer solution and salt concentration (globally ionic strength), were evaluated in the effectiveness of the sulfur-gold linkage and further influence on the biomolecular recognition between single stranded DNA molecules. A third, not less important variable under investigation was the blocking solution. Non-specific adsorption of magnetic labels to the sensing surface still is a major problem to be addressed. The effect of two well known blocking molecules (bovine serum albumin (BSA)) and thiolated polyethylene-glycol (SH-PEG)) on the prevention of non-specific adsorption of targets and labels are compared. The best conditions were selected using an optical microscopic characterization method. Optical images were analyzed for magnetic particles quantification and results presented as a percentage of surface coverage. The optimized protocol was further implemented on real magnetoresistive devices to assess its electric compatibility and bioassay performance. A good reproducibility (about 9% error) among different devices measuring the same target concentration was achieved. Also a reduced non-specific binding signal of 43 microV for non-complementary targets (30% complementarity) compares with a 500 microV for fully complementarity. A linear range on the biological detection of magnetically labeled target ssDNA oligonucleotides is demonstrated. Consequently, the limit of detection at the standard operational conditions of the device is situated at the picomolar range.

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