Multi-scale magnetic nanoparticle based optomagnetic bioassay for sensitive DNA and bacteria detection - DTU Orbit (09/11/2017)

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Benefiting from their rapid readout, highly flexible devices and low-cost portable systems, optomagnetic biosensors have drawn increased attention in recent years as bioassay technologies for small molecules, biomarkers, DNA, and bacteria. Herein, an optomagnetic bioassay strategy suitable for point-of-care diagnostics, utilizing functionalized magnetic nanoparticles (100 nm) with Brownian relaxation behavior is optimized in order to obtain higher detection sensitivity for DNA molecules and bacteria. Presence of target DNA sequences or bacteria changes the dynamic behavior of the magnetic nanoparticles (binding to the target) and thus the optomagnetic response of the sample, which is measured by an optomagnetic setup including a 405 nm laser and a photodetector. The limit of detection is mainly set by the lowest measurable concentration of magnetic nanoparticles. Herein, as new results compared to previous work, we systematically optimize the concentration of 100 nm magnetic nanoparticles to increase the assay sensitivity and lower the limit of detection. To enable biplex detection, we perform this optimization in the presence of larger 250 nm magnetic nanoparticles that do not interact with the target. We show that the optimization and lowering of the 100 nm magnetic nanoparticle concentration result in a limit of detection of 780 fM of DNA coils formed by rolling circle amplification (size of about 1 μm) and 10^5 CFU per mL Salmonella (for immunoassay). These values are 15 times lower than those reported previously for this readout principle. Finally, we show that the 250 nm magnetic nanoparticles can serve as a second detection label for qualitative biplex detection of DNA coils formed by rolling circle amplification from V. cholerae and E. coli DNA coils using 100 nm and 250 nm magnetic detection nanoparticles, respectively.

General information

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Organisations: Department of Micro- and Nanotechnology, Magnetic Systems, Uppsala University
Authors: Tian, B. (Ekstern), Zardán Gómez De La Torre, T. (Ekstern), Donolato, M. (Intern), Hansen, M. F. (Intern), Svedlindh, P. (Ekstern), Strömberg, M. (Ekstern)
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