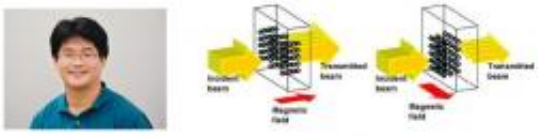
Self-assembly and chains of rotating magnetic particles

October 26 2010, By Adarsh Sandhu



Dr Park and Fig. 1: Experimental procedure for homogenous biosensing protocol based on chains of self-assembled magnetic particles rotating in solution. Copyright : Toyohashi University of Technology

Dr. Park and colleagues report on a new biosensing protocol based on monitoring changes in optical transmittance of a solution containing self-assembled chains of functionalized magnetic beads being rotated by an external magnetic field.

Biosensing based on the detection of magnetic labels offers a rapid, sensitive and inexpensive protocol for point-of-care medical diagnostics, where magnetoresitive sensors are used to detect magnetic beads immobilized onto substrates via biorecognition processes.

However, this approach necessitates multiple steps – immobilization of probe molecules, washing to remove non-specific binding, and so on – constraints which limit the sensitivity, speed and cost, and ultimately the size of the system.

In an alternative approach Sang Yoon Park at the Electronics Inspired Interdisciplinary Research Instiute (EIIRIS), Toyohashi Tech and colleagues at Tokyo Institute of Technology, report on a new biosensing protocol based on monitoring changes in optical transmittance of a solution containing self-assembled chains of functionalized magnetic beads being rotated by an external magnetic field. Importantly, this so-called homogenous method is rapid, highly sensitive over a wide range of concentration and does not require substrates or magnetic sensors.

The lengths of chains of biotinylated magnetic beads rotating in a solution increased with the addition of complementary biomolecules (avidin) to the solution, and importantly, the increase in chain length was directly related to the concentration of avidin added to the solution. This change in the length of the chains was measured with high accuracy by monitoring changes in the optical transmission of the rotating chains in the solution. Notably, optical transmittance through the solution depended on the lengths of the rotating chains, which in turn was related to the concentration of avidin molecules added to the solution.

The experimental set-up consisted of three simple components: a light source of a non-polarized white beam, a cuvette containing a solution of functionalized magnetic beads, and a compact spectrometer. The biotinylated magnetic beads used by the researchers had a diameter of 250 nm, and consisted of superparamagnetic particles embedded into a polymer matrix. The polymer surface was covered with biotin biomolecules and the concentration of avidin added to the solution was measured by applying a rotating magnetic field to the cuvette and monitoring optical transmission of the solution when the target molecule (avidin) was added to the solution.

In 30 seconds, the researchers quantitatively determined the concentration of avidin added to the solution with a sensitivity of 100 pM and a dynamic range of at least four orders of magnitude. This

protocol is a rapid, highly sensitive, inexpensive and homogeneous means for quantifying biorecognition processes.

More information: *Nano Letters* 10 446 (2010)
DOI:10.1021/nl9030488