

Magnetic Gold-Iron Alloy Nanoparticles and Reader for High Sensitivity Lateral Flow Immunoassay

i-colloid™ gold-iron alloy (AuFe) nanoparticles

IMRA's pulsed laser ablation (PLA) technology enables fabrication of novel magnetic gold-iron alloy (AuFe) nanoparticles. At a composition of Au₅₅Fe₄₅ at.% and an average size of 100 nm, the particles have near-zero magnetic coercivity and a strong saturation magnetic moment (a characteristics known as superparamagnetism, Fig. 1), making them suitable for biological applications such as magnetic separation and as magnetic probes in lateral flow immunoassay. The particles also display a dark color, providing good visual contrast as colorimetric probes on nitrocellulose membranes.

i-colloid™ AuFe nanoparticles in lateral flow immunoassay

AuFe nanoparticles were evaluated as dual probes for colorimetric and magnetic signals in a lateral flow immunoassay. Detection of human chorionic gonadotropin (hCG) in the standard lateral flow immunoassay format (Fig. 2) was established as a demonstration of the high sensitivity enhanced by the AuFe nanoparticles. The AuFe nanoparticles were conjugated with anti-hCG antibodies via Anteo Technologies's AnteoBind® (www.anteotech.com). Different concentrations of hCG ranging from 100 - 0.001 ng/ml were assayed in half strip format. Colorimetric signals and magnetic signals of the anti-hCG detection lines were measured with an optical reflectance reader and a magnetic reader (under development at IMRA America, Inc.), respectively.

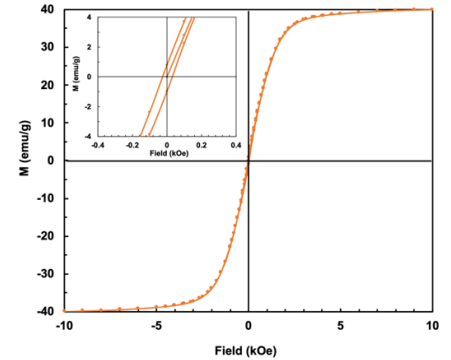


Fig.1 Magnetization curve of AuFe nanoparticles.

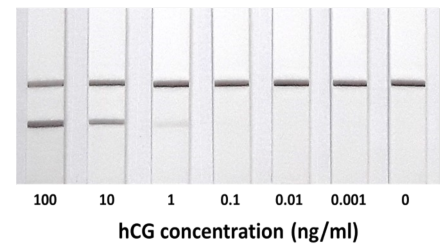


Fig. 2 hCG lateral flow assays

Figure 3 shows examples of magnetic 2D images of hCG test lines with hCG concentrations of 1 ng/ml (left) and 0.1 ng/ml (right). High sensitivity magnetic imaging produces images of test lines at low hCG concentrations of 0.1 ng/ml and below, which are invisible to naked eyes. The continuous background outside the test line in Fig. 3(right) reveals unbound particles trapped in the membrane. Figure 4 displays the hCG dose response curves based-on colorimetric signals (left) and magnetic signals (right). The colorimetric signals have a typical lowest detection limit at 0.1 ng/ml. The magnetic signals have a wider dynamic range and good responses at low concentrations of 0.01 ng/ml and below, demonstrating a superior sensitivity beyond colorimetric detection.

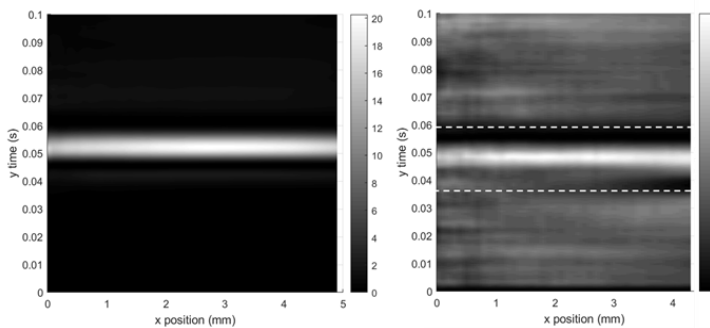


Fig.3 Magnetic 2D images of hCG test lines of different hCG concentrations. Left: 1 ng/ml, Right: 0.1 ng/ml

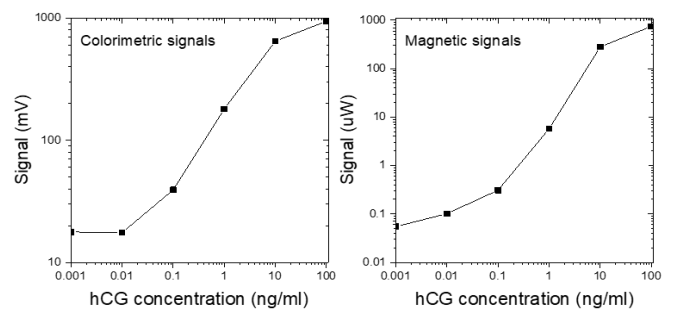


Fig. 4 hCG dose response curve measured with (left) colorimetric reader and (right) magnetic reader.