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Self-assembly of Superparamagnetic Particles for High-speed Magneto-optical Modulators and Biosensors

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A promising approach for the fabrication of optical modulators and detection of magnetically labled biomolecules [1] is based on monitoring the optical transmittance of magentically induced self-assembly of funtionalized superparamagnetic beads (SPB) in aqueous solutions. However, reports so far show that the response time of optical modulation to be slow, and the optical set-up complicated. Here, we demonstrated a simple, high-speed magneto-optical modulator utilizing rotatable SPB chains. Fig. 1 shows the variation of the intensity of transmitted light (wavelength of 487 nm) with the angle (θ) between the directions of the applied magnetic field and incident light. The optical transmittance was found to depend on the orientation of the SPB chains. Therefore, the chains act as optical transmittance valves. The switching speed of transmittance was in the millisecond range. Based on these results, we will propose a new simplified, high-speed method for optical modulation and biomolecule-sensing.

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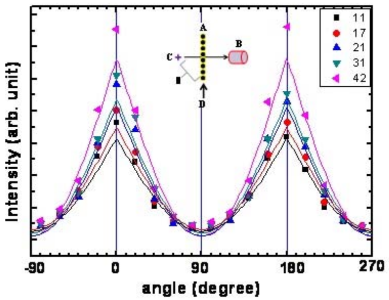

Fig. 1. Variation of the optical transmittance with magnetic field strength and angle of incident light. Symbols in inset: A:SPB-chain; B:microscope; C:487 nm wavelength light; D:magnetic field; θ:angle between incident light and magnetic field.

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CD03

Growth Controlled Magnetite Nanoparticles in the Aqueous Microdroplets and their Magnetic Properties

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The nanoparticle materials often exhibit very interesting electrical, optical, magnetic and chemical properties, which cannot be achieved by their bulk counterparts. In this paper, we report the synthesis and characterization of the Fe_3O_4 nanoparticles by a chemical coprecipitation technique through the pipette drop (pipette diameter: 2000 mm) and the piezoelectric nozzle method (nozzle size: 50 mm). And their physical and magnetic property were characterized by TEM, XRD and SQUID. A molar ratio of Fe(II)/Fe(III) = 0.5 was dissolved in distilled water with sonicator. The result solution was poured with piezoelectric nozzle method into alkali solution and black precipitates were formed immediately. X-ray diffraction was measured for the estimation of average particle size of synthesized magnetite and all the results were compared with TEM image. For the estimation as MRI contast agent, the magnetic property of synthesized magnetite was finally measured by Vibrating Sample Magnetometer.

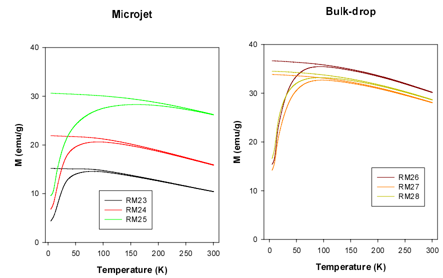

Fig. 1. Magnetic property of synthesized iron oxides.

$FeCl_2$ (1mol) + $FeCl_3$ (2mol) → Fe_3O_4

Drop size of the iron source was affect on not only the size and shape of the nanoparticles but also the magnetic properties. The effect of drop size of the iron solution were measured by various analytical methods. XRD peak shows that the particle size control was possible only when the microjet was used. And the peak position was precisely matched with the one of bulk magnetite not the haematite nor any other iron oxides. Magnetization of magnetite were definitely controlled through the microjetting device and this proves that the physical property can be controlled in chemical coprecipitation

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