NOVEL THERMO-RESPONSIVE MAGNETIC NANOPARTICLES

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INTRODUCTION: Magnetic support materials have been widely used in the field of biotechnology such as bioseparations, immunoassay, immobilization of enzymes and drug carriers. Previously, we have reported on thermo-responsive magnetic nanoparticles showing lower critical solution temperature (LCST), which could be flocculated and separated quickly from solution under magnetic field by elevating the temperature [1,2]. However, for the separation of unstable proteins, high temperature should be avoided. Recently, we have developed novel thermo-responsive copolymers showing upper critical solution temperature (UCST). They were synthesized by copolymerizing *N*-substituted acrylamide such as acrylamide or methacrylamide and *N*-acetylacrylamide or *N*-formylacrylamide, respectively [3]. In this report, we describe novel thermo-responsive magnetic nanoparticles and their applications.

METHODS: In our UCST polymer, we have chosen the copolymer composed of *N*-acryloylglycineamide and biotin monomer because biotin is useful for various biological experiments. The biotin monomer was synthesized as shown in Figure 1.

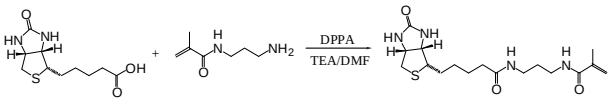

Fig. 1: Synthesis procedure for biotin monomer.

Monomers were copolymerized in the presence of magnetic nanoparticles to prepare thermo-responsive magnetic nanoparticles.

RESULTS AND DISCUSSION: The thermo-responsive magnetic nanoparticles coated by UCST copolymer show the same properties as the copolymer. The particles were dispersed in water at higher temperature than the UCST. On cooling the solution below UCST, the particles were aggregated and collected quickly by the magnet (Figure 2).

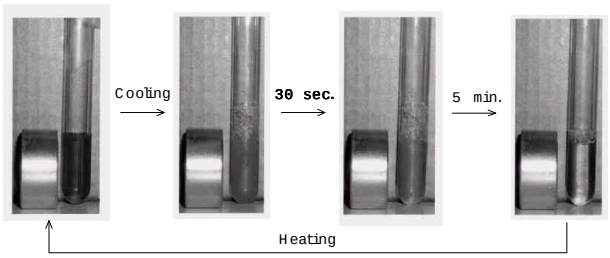

Fig. 2 : Response of modified magnetic nanoparticles to a magnetic field after lowering the temperature below the UCST.

The particles modified by biotin bound avidin in egg white solutions and could easily be separated with a magnetic field after lowering the temperature (Figure 3).

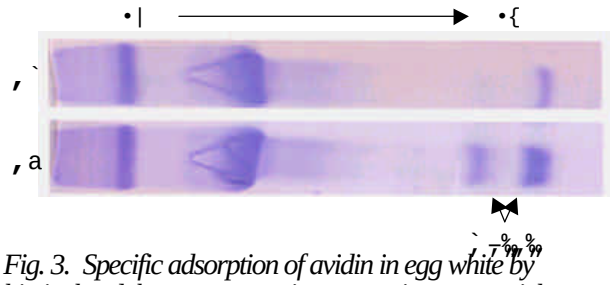

Fig. 3. Specific adsorption of avidin in egg white by biotinylated thermo-responsive magnetic nanoparticles. Lane A: Supernatant after flocculation and collection of particles. Lane B: Egg white solution before addition of particles.

Our results suggest that the magnetic nanoparticles provide various applications employing the avidin-biotin binding system. We are going to report methods of adding new functions to the particles and their applications in enzyme immobilization and cell separations.

REFERENCES: [1] Kondo et al (1994) *Appl. Microbiol. Biotechnol.*, **41**:99-105. [2]Kondo et al (1997) *J. Ferment. Bioeng.*, **84**:337-341. [3]Ohnishi et al. (2002) in press.