Using Magnetic Field Gradients to Shorten the Antigen-AntibodyReaction Time for a Magnetic Immunoassay

Keiji Tsukada[1], Kenta Tsunashima[1], Katsuya Jinno[1], Bunta Hiramatsu[1], Shun Takeuchi[1], Kayo Fujimoto[1], KenjiSakai[1], Toshihiko Kiwa[1], and Mohd Mawardi Saari[2]

[1]Graduate School of Interdisciplinary Science and Engineering in Health Systems, Okayama University, Okayama 700-8530, Japan

[2]Faculty of Electrical and Electronic Engineering, University Malaysia Pahang, 26600 Pekan, Malaysia

ABSTRACT

The measurement of biological targets using nanoparticle magnetic markers has been extensively studied for its applications in magnetic immunoassays (MIAs). Compared with the optical immunoassay method, the MIA methods have some attractive characteristics such as a wash-free process that does not need bound/free marker separation and the ability to detect biological targets in a nebulous liquid. In addition, the wash-free process is very fast. In this paper, we tried to reduce the reaction time for the antigen-antibody reaction in order to make the MIA method more attractive. The reduction in reaction time and the detection characteristic of biological targets were demonstrated using C-reactive proteins (CRPs) as biological targets for diagnosing inflammation. To shorten the reaction time, a magnetic-shaking method using the magnetic field gradient from a neodymium magnet was developed. When comparing the reaction times with and without magnetic shaking, it was found that the reaction time decreased with magnetic shaking for all CRP concentrations. Even after the magnetic-shaking treatment, the dependence of the CRP concentration on the magnetic signal was observed. The number of surface modifications per magnetic marker and the magnetic marker concentration also affected the reaction time. In order to obtain the desired measurement range based on the CRP response characteristic, it is necessary to optimize the number of magnetic markers and polymer beads used.

KEYWORDS: Antigen-antibody reaction, C-reactive protein (CRP), magnetic field gradients, magnetic immunoassay (MIA),magnetic nanoparticles (MNPs).

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