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Effects of magnetic field on water investigated with fluorescent probes

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Abstract

Aqueous solutions with dissolved fluorescent probes were exposed to a magnetic field, and the effects of the magnetic exposure were investigated by measuring the fluorescence emission intensity with a spectrofluorophotometer. The data were compared with those of magnetic exposure effects on colloidal solutions reported previously [K. Higashitani, K. Okuhara and S. Hatade, J. Colloid Interface Sci., 152 (1992) 125; K. Higashitani, H. Isari, K. Okuhara, A. Kage and S. Hatade, J. Colloid Interface Sci., 172 (1995) 383]. It is found that (1) the degree of magnetic effects increases with the magnetic exposure and becomes constant at a certain exposure time in the case of solutions of fluorescent probes with an alkyl chain, but no effect was observed for solutions of probes without an alkyl chain; (2) the magnetic effects decay with the concentration of alcohol in the solution, the solution temperature, and the standing time of the solution after the magnetic exposure; and (3) if it is presumed that an ordered structure of water molecules around the hydrophobic chain of probes is formed by the magnetic exposure, not only are the results in the present study but also are our previous results for colloidal particles explained consistently.

Keywords: Aqueous solutions; Fluorescence; Fluorescent probes; Magnetic field effects; Memory effect; Water structure

1. Introduction

All the materials on earth, including living organisms, have been exposed to the geomagnetic field and the occasions on which we are exposed to an anthropogenic magnetic field, such as magnetic resonance imaging, are increasing. Hence it is fundamentally important to investigate the effects of magnetic exposure on materials.

The effects of a magnetic field on aqueous solutions [1–11] and biomaterials [12,13] have been investigated in various fields, but these effects have been mysterious in the sense that the effects arise from the exposure of materials to a magnetic field of low flux density and they remain even after the magnetic exposure is completed. These phenomena are classified into the following categories: (1) phenomena for magnetic materials which are understandable using current electromagnetic theory; and (2) phenomena for non-magnetic materials which are not understandable by current electromagnetics. We are interested only in the latter.

Recently Higashitani et al. reported quantitative data concerning the effects of magnetic exposure on the rapid coagulation rate of polystyrene latices (PSL) in solutions [9], data relating to magnetic exposure effects on the formation of $CaCO_3$ crystals from $CaCl_2$ and Na_2CO_3 solutions [10], and data concerning magnetic exposure effects on the zeta potential and diffusivity of PSL in electrolyte solutions as well as a possible mechanism to

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