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Right-handed and left-handed orientation of biological macromolecules under magnetic field

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Introduction

Most of previous works including ours studied phase behaviors and aggregative phenomena of biological macromolecular suspensions under homogeneous magnetic field [1]. Only a rotational force from magnetic field was used for such studies, while a translational force from magnetic field gradient has been mostly disregarded. Then we have developed a high-performance compact magnetic circuit to investigate orientational phase behaviors of biological and synthetic macromolecular systems by using spectroscopic methods such as X-ray scattering and light scattering. This magnetic circuit can apply a periodic magnetic field and gradient to samples. Owing to the periodicity of the magnetic field strength and gradient, macromolecules are able to be subject to both rotational and translational forces from magnetic field. We expect that such a translational force not only causes various interesting behaviors of macromolecular systems under magnetic field but also is applied to a control of assembling processes of macromolecules.

Experimentals

Fig. 1 shows the schematic perspective side view of the magnetic circuit. This circuit can apply a high periodicity of both the magnetic field strength and gradient from 1.5 tesla (2.4 x 10^2 tesla/m) to 0.55 tesla (7.3 x 10^1 tesla/m) over 2.5 periods with 4.4 cm/period. The details of the the characteristics will be shown elsewhere [2]. SR-SAXS experiments were carried out with a small-angle scattering spectrometer installed at BL-15A at PF, KEK, Tsukuba, Japan. The sample we used was tobacco mosaic virus (TMV) which is one of rod-shaped plant viruses with 300 nm in height and 18 nm in diameter.

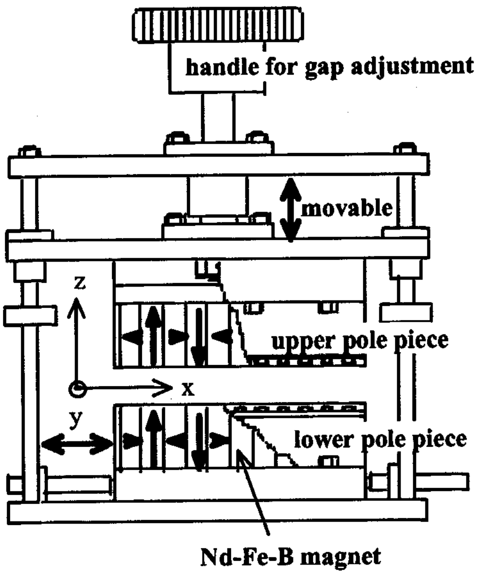

Fig. 1. Schematic perspective side view of the magnetic circuit. The thick arrows indicate magnetization .

Results and Discussions

Fig. 2 shows the time courses of the scattering patterns of the orientational processes of TMV suspension (90 mg/ml) at nematic liquid crystalline phase under the opposite magnetic-field directions, where we used 2-D CCD detector. Fig. 2 indicates that the direction of magnetic field defines the rotational direction of TMV long-axis, which would result from the translational forces induced by the magnetic-field gradients with the opposite directions.

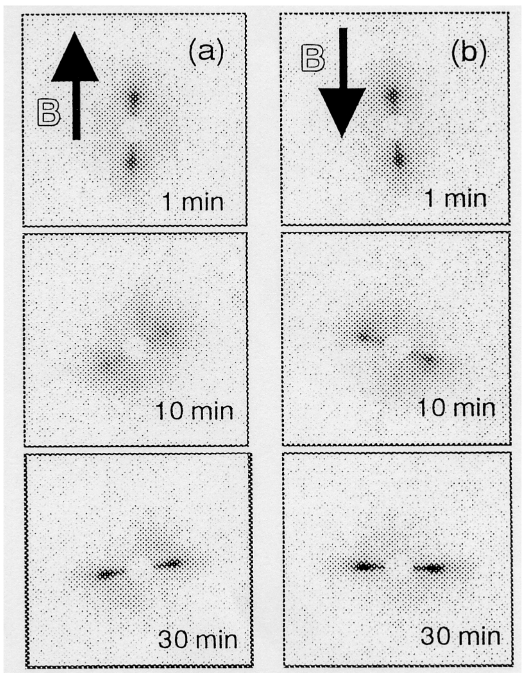

Fig. 2 Change of 2-D scattering pattern of the TMV suspension under the opposite magnetic-field directions.

References

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