803rd ASRC Seminar

Date：6月25日 (金), 13:30~15:00

Location：先端基礎交流棟 ロビー & Zoomによるオンライン開催

Speaker： 成島哲也　氏 (自然科学研究機構　分子科学研究所)

Title：Circular dichroism imaging for analysis of materials chirality and attempts to control gyromagnetic effect by circularly polarized light

(円二色性イメージングによるキラル物資分析と磁気回転効果の円偏光による制御の試み

Abstract:

Measurement of circular dichroism (CD) has been utilized to analyze chirality in tiny molecules. In recent years, CD of spatially extended materials, such as crystals, molecular assemblies and metallic nanostructures, has also been studied. Nanoscale local CD imaging was demonstrated to be informative for the analysis of chiroptical properties of nano- to micro-scale materials [1]. Microscopic CD imaging enables direct visualization of the spatial CD signal distribution. However, CD imaging has not been commonly employed, because artifacts arising from linear dichroism (LD) of the sample interfere in the CD signal obtained by the conventional CD detection method, which prevents accurate CD detection. Recently, we developed a CD microscope based on a novel polarization modulation method, which greatly suppressed the interference from LD, and achieved reliable CD imaging with a high sensitivity at a diffraction limited spatial resolution [2]. Various hierarchical chiral structures which exist from subnano- to micro-meter scales have been successfully studied with this CD microscope [3].

If a particle suspended in free space is rotated, the particle can be magnetized slightly. The magnetization effect increases with rotational speed. Recently, GHz-order mechanical rotation of nanoparticle has been demonstrated by optical trapping technique with circularly polarized light (CPL) [4]. The rotational manipulation with extremely high rotational-speed will reveal detailed properties of the gyromagnetic effect and also can be a new tool to detect quantum spins. For these purposes, our non-linear optical trapping technique [5] and high-speed CPL modulation established in our CD microscope [2] must enhance capabilities to regulate mechanical rotation of the nanoparticles and tune the gyromagnetic effect in nanospace.

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[2] T. Narushima, H. Okamoto, Sci. Rep., 6, 35731 (2016), 特許6784396号, 特願2021-029181号.

[3] P. Szustakiewicz et al., ACS Nano, 14, 12918-12928 (2020), T. Yamada et al., Chem. Eur. J., 25, 6698-6702 (2019), 成島哲也, 岡本裕巳, 生物物理, 59, 035-038 (2019).

[4] R. Reimann et al., Phys. Rev. Lett., 121, 033602 (2018).

[5] Y. Jiang, T. Narushima, H. Okamoto, Nature Physics, 6, 1005–1009 (2010).

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