Experimentelle Physik 2

Seminar Festkörperphysik (CMP Seminar)

Aktuelle Probleme der Festkörperphysik für Studenten und Mitarbeiter
020236 Kolloquium/Seminar SS 25
Vorlesungszeit: 10.04.2025 – 24.07.2025

Thursday, 12.06.2025
12:10 – P1-01-306

Higher-order magnetooptic Kerr effect in magnetic thin films

Timo Kuschel

Faculty of Physics, Bielefeld University, 33615 Bielefeld, Germany
Institute of Physics, Mainz University, 55122 Mainz, Germany

The magneto-optic Kerr effect (MOKE) describes the change of polarization state apon reflection of polarized light from a magnetized sample [1]. Initially this effect has been assumed to be proportional to the magnetization M of the investigated sample and, thus, became a standard tool to study magnetic thin-film systems [2]. However, in the last two decades contributions of second order in M have been explored [3]. The so-called quadratic MOKE (QMOKE) is proportional to M^2 and is, e.g., utilized to study antiferromagnetic materials [4] since the MOKE linear in M (LinMOKE) vanishes here due to the antiparallel alignment of the magnetic moments.

In my talk, I will introduce higher-order MOKE effects and discuss recent examples. We have investigated the QMOKE in Fe [5] and Heusler compound thin films [6], and confirmed the linear dependence of the QMOKE on the structural order of the Heusler compound in a wide spectral range. Furthermore, we explored the third-order MOKE called cubic MOKE (CMOKE) being proportional to M^3 in Ni(111) thin films [7]. We found a strong dependence of the CMOKE on the structural domain twinning of the Ni thin films characterized by off-specular x-ray diffraction mappings. Thus, this effect could be of future use in MOKE microscopy and time-resolved MOKE to determine the creation and manipulation of structural domain twins in space and time.

[1] J. Kerr, Lond. Edinb. Dublin philos. mag. j. sci. **3**, 321 (1877).
[2] Z. Q. Qiu and S. D. Bader, Rev. Sci. Instrum. **71**, 1243 (2000).
[3] J. Hamrle *et. al.*, J. Phys. D: Appl. Phys. **40**, 1563 (2007).
[4] J. Xu *et al.*, Phys. Rev. B **100**, 134413 (2019).
[5] R. Silber, TK *et al.*, Phys. Rev. B **100**, 064403 (2019).
[6] R. Silber, TK *et al.*, Appl. Phys. Lett. **116**, 262401 (2020).
[7] M. Gaerner, TK *et. al.*, Phys. Rev. Applied **22**, 024066 (2024).