PhD offer

Switchable liquid crystal metamaterials for THz applications

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Terahertz (THz) is the far-infrared part of the electromagnetic spectrum, lying between the domains of infrared optics and microwaves. Because of promising foreseen applications, THz technology has experienced a rapid development in the last few years due to the emergence of reliable sources and detectors. A wider application of the technology demands for several additional optical components like phase-modulators, filters, etc. Especially switchable and/or tunable elements are highly needed. One possible solution to this problem is the usage of liquid crystals (LCs) based metamaterials (MMs).

LCs reveal an intrinsic birefringence, which permits to manipulate the properties of THz radiation by orientating the molecules via external parameters, like electric or magnetic fields. Although the basic idea has been demonstrated in the literature, the overall birefringence in the published results remains very small. Another very promising approach to control the propagation of electromagnetic radiation is based on MMs. MMs are artificial structures, in which the electromagnetic properties can be tailored to obtain values not reachable in natural materials. However, after a MM has been produced, its properties cannot be changed anymore and therefore they can hardly be switched or tuned. In combination, one can make use of the advantages of both constituents, namely the tunability of LCs by external parameters, as well as the freedom in design of MMs. It is expected that, in such a coupled structure, even if the changes in the LC are nominally small, electromagnetic resonances within the MM lead to substantial effects.

The objectives of this thesis are manifold. Besides the study of new classes of LCs using time resolved spectroscopy in the terahertz range (THz-TDS) and the evaluation of their tunability using electric/magnetic fields as well as optical intensity, also the goal of this thesis embraces the design, production and characterization of MMs. The most performing materials and structures will be combined to form innovative hybrid devices, which will be finally characterized.

The work will be embedded in the framework of wide scientific European collaboration network, involving mostly IMEP-LAHC laboratory at University Savoie Mont-Blanc, Saint-Louis Institute nearby Mulhouse, and University of Marburg. Worldwide collaborations (Australia, Hong Kong…) regarding this study have already been established. The grant of 2210€/month is already funded. The candidate must hold a European citizenship, and preferably German or French. If you are interested, please contact us:

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