

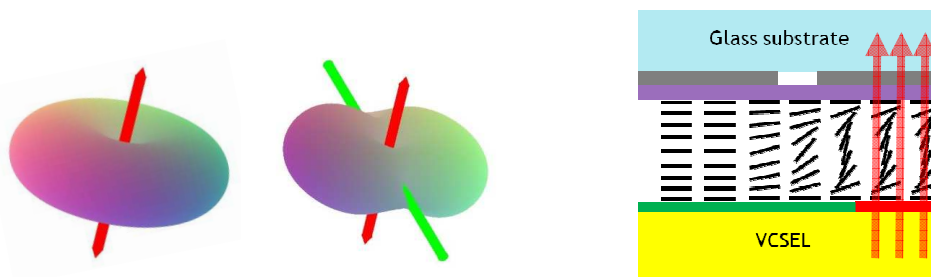
Spontaneous and stimulated light emission from devices with anisotropic materials

K. Neyts,^{*1,2} L. Penninck,^{1,2} Y. Xie,^{1,2} I. Nys,^{1,2} P. De Visschere,^{1,2} and J. Beeckman^{1,2}

1 LCP group, ELIS Department, Ghent University, Ghent, Belgium
2 Center for Nano and Biophotonics, Ghent University, Ghent, Belgium

It is well known that many dye molecules align their long axis parallel to the director of the nematic liquid crystal in which they are dissolved. The light emission from such a dye-doped liquid crystal is strongly polarized and the **radiant intensity** depends on the angle of observation.

Anisotropy in a material can have an important influence on the light emission properties. The main effect is that the atoms, molecules or nanoparticles that emit light may have a preferential orientation. When the light emission is due to an electrical dipole transition along a certain axis, most light will be emitted in the plane perpendicular to that axis. The optical anisotropy of the material further determines how the refractive index of the light depends on the polarization and propagation direction of the light. The emission from oriented emitters in structures consisting of anisotropic layers can be determined with a simulation tool [1]. This tool has been used to predict the emission pattern for OLEDs with oriented dipole emitters and for CLCs with fluorescent dyes.



Emission pattern for an electrical dipole in an isotropic (left) and anisotropic (middle) medium. Right: vertical-cavity surface-emitting laser covered with a nematic liquid crystal layer.

Recently we have investigated lasing in different one-dimensional structures containing liquid crystal:

- Chiral nematic liquid crystal devices doped with fluorescent dyes. In this case the structure is optically pumped with a pulsed 532 nm laser [2].
- Solid state vertical-cavity surface-emitting lasers (VCSEL) covered with a layer of nematic or chiral nematic liquid crystal [3].

The importance of the orientation of the emitters, the role of the liquid crystal and the optical cavity will be discussed. Anisotropic emitters may be used for enhancing the outcoupling in OLEDs, improving the efficiency of fluorescent solar concentrators or developing tunable lasers with low threshold.

References:

- [1] L. Penninck, *et al.*, "Dipole radiation within one-dimensional anisotropic microcavities: a simulation method," *Optics Express*, vol. 19, pp. 18558-18576, Sep 12 2011.
- [2] L. Penninck, *et al.*, "Numerical simulation of stimulated emission and lasing in dye doped cholesteric liquid crystal films," *Journal of Applied Physics*, vol. 113, Feb 14 2013.
- [3] Y. Xie, *et al.*, "Vertical-Cavity Surface-Emitting Laser With a Chiral Nematic Liquid Crystal Overlay," *IEEE Photonics Journal*, vol. 6, 1500010, Feb 2014

* presenting author; E-mail: kneyts@elis.ugent.be