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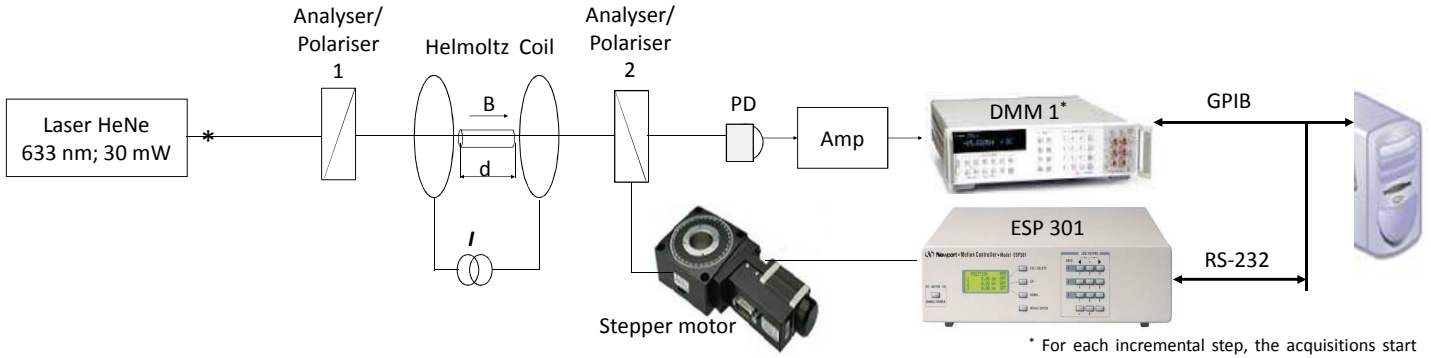
Determination of the Verdet Constant of Low Birefringence Single-Mode Optical Fiber

D. Istrate[1], R. Etienne[1], J. Dubard[1], A. Litwin[1], O. Enouf[1]
[1]LABORATOIRE NATIONAL DE MÉTROLOGIE ET D'ESSAIS

Abstract. The Faraday rotation effect of the light polarization is used in the fabrication of optical current sensors. A quantitative measure of the Faraday rotation ability of the material is given by the material property called Verdet constant. The measurements of the Verdet constant of undopped single-mode spun optical fibers for the 632.8 nm wavelength have been carried out.

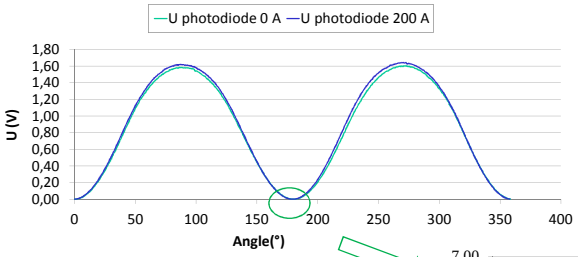
Experimental setup

- Linearly polarized light
- Homogeneous magnetic field
- High precision rotation stage with very small incremental motions to control the position of the Analyser 2
- Low noise Silicon photodetector



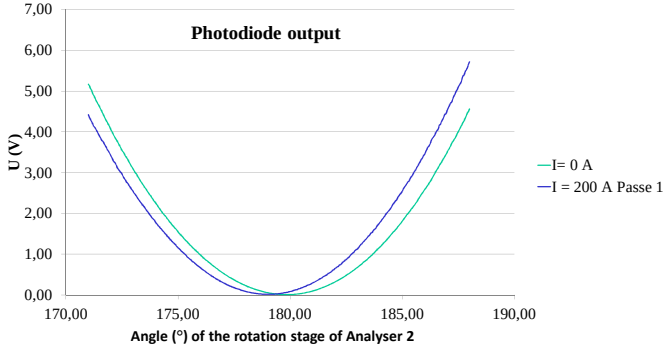
* For each incremental step, the acquisitions start when the motor has reached the required position.

Measurement principle

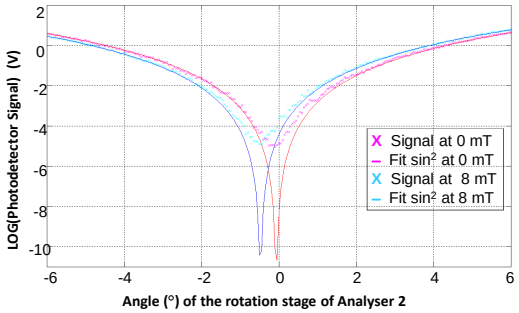


The analyser 2 is rotated around the minimum of the photodetector signal with adjustable angle step. Two acquisitions are performed: without and with the magnetic field.
A least square alghorithm is applied on the acquired data to determine the parameters of the analytical functions that fit to the experimental data.

Since the Faraday rotation angle is very small (< 1°) for this type of fibers, in order to increase the sensitivity, we choose to rotate the analyzer on an angle range around the minimum of the photodetector signal (cross polarized configuration with respect to the output polarization).



Results



$$u_1(\theta)\Big|_{I=0\,A} = A_1 \cdot sin^2(\theta + \varphi_1)$$

$$u_2(\theta)\Big|_{I=200\,A} = A_2 \cdot sin^2(\theta + \varphi_2)$$

Faraday rotation angle:

$$\varphi\,(rad) = \varphi_2 - \varphi_1$$

Verdet constant:

$$V = \frac{\varphi}{d \cdot B}\,(rad/T \cdot m)$$

Wavelength		632.8 nm	
Magnetic field		8. 16 mT	
Temperature		(21.0 ± 2.0) °C	
Spin pitch : 7 mm		Spin pitch : 5 mm	
Rotation angle (°)	V (rad/T·m)	Rotation angle (°)	V (rad/T·m)
0.74	3.97	0.84	4.5

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