

Supplementary Materials: Optical chirality determined from Mueller matrices

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1. Depolarization

Some of the samples studied exhibit depolarization. This can be quantified with the depolarization index defined by [1]

$$P_D = \sqrt{\frac{\sum_{ij}(m_{ij}^2 - m_{11}^2)}{3m_{11}^2}}, \quad (1)$$

where m_{ij} ($i,j=1..4$) are Mueller matrix elements.

In addition we present, for some samples, the depolarization matrix \mathbf{L}_u obtained in a differential decomposition $\mathbf{L} = \ln \mathbf{M} = \mathbf{L}_m + \mathbf{L}_u$. In the notation in Ref. [2], this matrix can be written as

$$\mathbf{L}_u = \begin{bmatrix} 0 & d_1 & d_2 & d_3 \\ -d_1 & -d_7 & d_6 & d_5 \\ -d_2 & d_6 & -d_8 & d_4 \\ -d_3 & d_5 & d_4 & -d_9 \end{bmatrix}, \quad (2)$$

where the isotropic absorption has been subtracted. The diagonal elements $-d_7$, $-d_8$ and $-d_9$ represent the anisotropic depolarizations for xy , ± 45 and circular polarizations, respectively, and the off-diagonal elements the uncertainties in the corresponding parameters in \mathbf{L}_m . A detailed analysis and physical interpretation of the elements of \mathbf{L}_u is found in Ref. [2].

1.1. Depolarization of *Cetonia aurata* cuticle samples

Figure S1 shows the depolarization indices for samples CA1 and CA2.

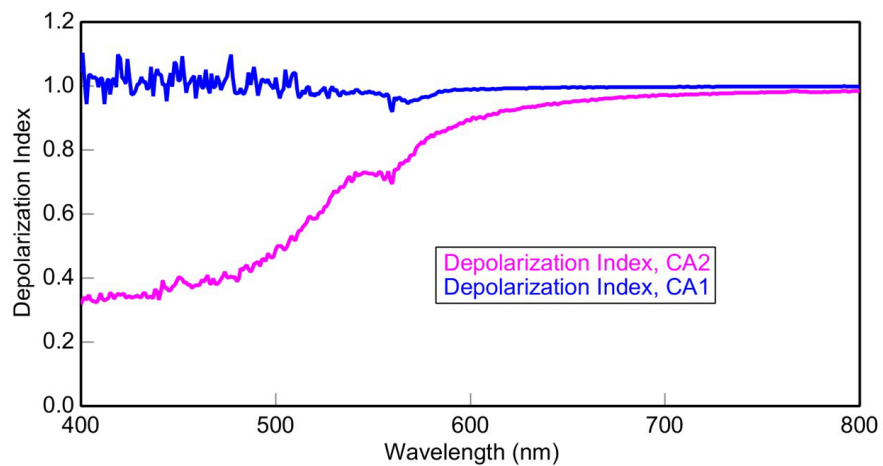


Figure S1. Depolarization index for cuticle samples CA1 and CA2.

A more detailed view of the depolarization is given by the \mathbf{L}_u matrices for samples CA1 and CA2 in Figures S2 and S3, respectively. All off-diagonal elements show small depolarization compared to the diagonal elements. The diagonal elements $-d_7$, $-d_8$ and $-d_9$ show depolarization for both linear and circular anisotropy for wavelengths

shorter than 600 nm. Sample CA2 has larger depolarization compared to sample CA1 confirming the data in Figure S1.

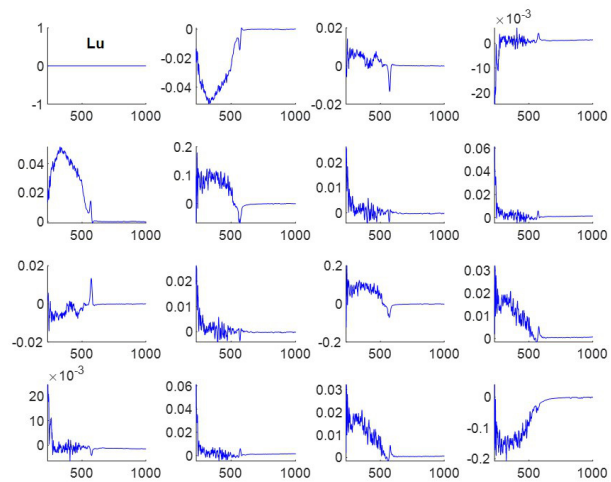


Figure S2. L_u matrix for sample CA1. Notice that autoscaling is used.

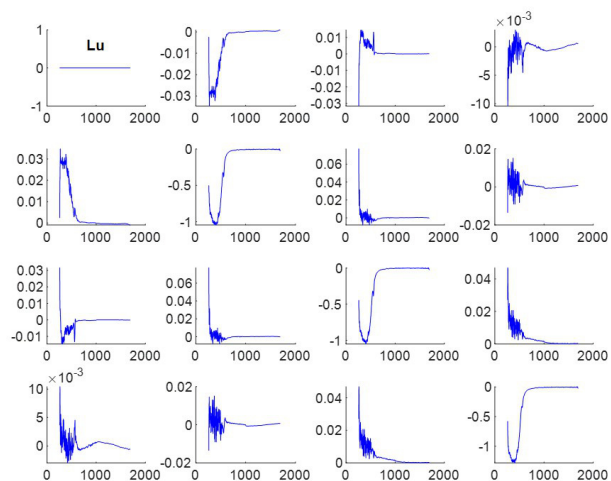


Figure S3. L_u matrix for sample CA2. Notice that autoscaling is used.

1.2. Depolarization of CNC samples

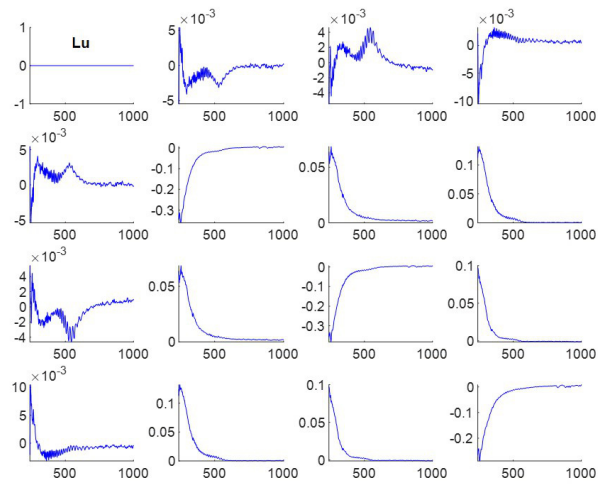


Figure S4. L_u matrix for sample CNC.

Abbreviations

The following abbreviations are used in this manuscript:

MDPI	Multidisciplinary Digital Publishing Institute
DOAJ	Directory of open access journals
CNC	Cellulose nanocrystals

References

1. Gil, J. J., Bernabeu, E. Depolarization and Polarization Indices of an Optical System. *Opt. Acta* **1986**, *33*, 185-189.
2. Ossikovski, R, Arteaga, O. Statistical meaning of the differential Mueller matrix of depolarizing homogeneous media. *Opt. Lett.* **2014**, *39*, 4470-4473.