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Fast near infra-red ferroelectric liquid crystal based Mueller matrix system for imaging and spectroscopy

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Abstract. The science and optical engineering of imaging Mueller Matrix Ellipsometry (MME) and Spectroscopic MME is currently being revitalized based on an efficient optimal design method, and through the use of the so-called Eigenvalue Calibration Technique (ECT). Through the ECT one may efficiently measure the details of the polarization state generator (PSG) matrix, and the polarization state analyzer (PSA) matrix, and hence avoid modeling of any unknown polarizing components in the system, and in particular the exact response of complex polarizing elements such as liquid crystal retarders. We here start up with presenting a detailed analysis of the dynamic response of a near infra red Ferroelectric Liquid Crystal based Mueller matrix ellipsometer (NIR FLC- MME) [1]. A time dependent simulation model, using the measured time response of the individual FLCs, is used to describe the measured temporal response. Furthermore, the impulse response of the detector and the pre-amplifier is characterized and included in the simulation model. The measured time dependent intensity response of the MME is well explained by simulations. A FLC based NIR-MME system is here shown to be able to operate accurately at the maximum speed of approximately 16 ms per Mueller matrix measurement (steady state response). We demonstrate here time dependent Mueller Matrix measurements of a dynamically changing sample, with even down to 8 ms sampling time of each complete Mueller Matrix (with some loss of accuracy). We secondly briefly present the NIR-FLC- MME imaging system, and show applications to strain imaging of a crystal subjected to an external pressure. Furthermore, we present near-infra-red Mueller matrix images and corresponding polar decomposition images of thin slices of bio-tissue [2].

References

1. L. M. Sandvik Aas, P. G. Ellingsen, M. Kildemo, F. Stabo-Eeg and M. Lindgren (manuscript in preparation)
2. L. M. Sandvik Aas, M. Kildemo, P. G. Ellingsen, F. Stabo-Eeg and M. Lindgren (manuscript in preparation)