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EDITORIAL
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Editorial: Advances in Polarimetry and Ellipsometry: Fundamentals and Applications

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Editorial on the Research Topic

Advances in Polarimetry and Ellipsometry: Fundamentals and Applications

Polarization is a fundamental property of light waves. Originating from polarization, there are two categories of techniques: polarimetry and ellipsometry. Polarimetry is the technique for measuring and interpreting polarization information, and ellipsometry usually refers to the polarimetry that characterizes thin films and surfaces using polarization changes. In the past decades, polarimetry and ellipsometry have shown promising applications in various fields, including target detection, biomedical imaging, characterization of surfaces and thin films, etc., while the theory, instrument, and polarization information interpretation for polarimetry and ellipsometry are constantly developing at the same time. We are glad to see that this special issue collects 13 articles, which report both the latest technological advances and the applications of polarimetry and ellipsometry.

In the field of polarimetry, remarkable works on polarimetric imaging in scattering media and polarimetry for biomedical applications have been covered in the current Research Topic. Shi et al. proposed a method to remove haze by using a self-supervised neural network that combines scene polarization information, which does not require any haze-free image as the constraint for neural network training. Song et al. proposed a method of polarization-imaging recovery in complex underwater environment based on investigating the scattering characteristics of underwater suspension particles and bubble by using the theory of radiation transfer. Wang et al. investigated the propagation of linear and circular polarized light in the scattering medium. They found that both the linear and circular polarimetric imaging had an ability to reduce the image degradation caused by smoke, and the propagation of the polarized light, especially the circular polarized light, is determined by medium conditions. Hu et al. review the recent advances of polarimetric imaging through scattering media from the perspectives of the principle, basic model, imaging configuration and applications, and they provide a brief summary and comparison across various methods in this Topic. Ivanov et al. measured the Mueller matrices of multiple formalin-fixed human colon samples including healthy and malignant regions, and investigated several unsupervised and supervised machine learning algorithms for histopathological classification based on polarimetric data. Wan et al. proposed a new angular-based Mueller matrix polarimetry parameter, and demonstrated that the proposed parameter can differentiate subwavelength pore sizes well. Xu et al. proposed a high-throughput method for online identification of bioaerosols based on multi-angle polarization index system, and showed that bioaerosols like pollen can be distinguished from other types of aerosols with this method.

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In the field of ellipsometry, remarkable works on instrumentation, methodology and applications have been covered in the current Research Topic. To achieve enhanced repeatability of the instrument in the applications in Integrated Circuit (IC) industry, Jiang et al. proposed a general optimal instrument matrix to minimize the estimation variance for both Gaussian additive noise and Poisson shot noise as well as a peak matching algorithm to compress the repeatability errors due to the bias of the trigger signal and the limited sampling frequency. Hansen et al. reported an improved calibration method for Mueller ellipsometry to detect the geometrical anisotropy of the structure, and further combined it with multiple instruments as a hybrid metrology to improve the measurement accuracy on three-dimensional periodic structures. Käseberg et al. reported their in-house Mueller matrix microscope based on an imaging system and a dual-rotating compensator configuration for the ellipsometric system, and further carried out the comparison of the results on a specific designed sample containing geometrical nanostructures with lateral dimensions ranging from 50 to 5000 nm to traceable atomic force microscopy measurements. Yao et al. proposed the quasi-Brewster angle technique (qBAT) based on ellipsometry to inspect the quality of polished Lu_2O_3 single crystal, to achieve fast, nondestructive, and high-sensitive surface/subsurface damage assessment. Li et al. utilized the Mueller Matrix Spectroscopic Ellipsometry on the nanoscale subsurface damage detection of 4H-SiC wafers induced by grinding and polishing, which could be expected to benefit process optimization in the whole wafer manufacturing. Dong et al. introduced their analysis model based on the rigorous coupled-wave analysis (RCWA) method to retract the correlation between the incidental and azimuthal angles and the reflectivity of different diffraction orders, with the objective to show the potential of the Morpho butterfly scales-based biosensor.

In summary, we hope that the collection presented in this Research Topic, "Advances in Polarimetry and Ellipsometry: Fundamentals and Applications", will contribute to the progress of research and development activities in the field.

AUTHOR CONTRIBUTIONS

All authors listed have made a substantial, direct, and intellectual contribution to the work and approved it for publication.

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