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論　文　内　容　要　旨

報告番号	甲　先　第　447　号	氏　名	是澤　秀紀
学位論文題目	近赤外光を用いた光計測の高度化に関する研究		

内容要旨

In this PhD thesis, we aim to advance three kinds of optical measurements by use of NIR light. This PhD thesis is organized by the following three topics.

(1) **Lock-in-detection dual-comb spectroscopy**

(2) **Dynamic characterization of polarization property in liquid-crystal-on-silicon spatial light modulator using dual-comb spectroscopic polarimetry**

(3) **Hybrid angular-interrogation surface plasmon resonance sensor based on beam-angle-scanning angular spectrum and beam-angle-fixed reflectance in the near-infrared region for wide dynamic range refractive index sensing**

In the first topic of this PhD thesis, we use an optical frequency comb (OFC) as the NIR light for enhancement of dual-comb spectroscopy (DCS). DCR is useful for gas spectroscopy due to the high potential of OFC. However, fast Fourier transform (FFT) calculation of a huge amount of temporal data spends significantly longer time than the acquisition time of an interferogram. In this topic, we demonstrate frequency-domain DCS by a combination of DCS with lock-in detection, namely LID-DCS. LID-DCS directly extracts an arbitrary OFC mode from a vast number of OFC modes without the need for FFT calculation. Usefulness of LID-DCS is demonstrated in the rapid monitoring of transient signal change and spectroscopy of hydrogen cyanide gas.

In the second topic of this PhD thesis, we introduce DCS of NIR optical comb in spectroscopic polarimetry (SP). SP is a powerful tool for characterization of thin film, polarization optics, semiconductor, and others. However, mechanical polarization modulation of broadband light hampers its application for dynamic monitoring of a sample. In this topic, we demonstrate the dynamic SP with features of polarization-modulation-free polarimetry and spectrometer-free spectroscopy benefiting from DCS using a pair of OFCs. DCS enables the direct determination of polarization without the need for polarization modulation by using mode-resolved OFC spectra of amplitude and phase for two orthogonally linear-polarized lights while securing rapid, high-precision, broadband spectroscopy without the need for spectrometer. Effectiveness of the proposed system is highlighted by visualizing the hysteresis property of dynamic response in a liquid-crystal-on-silicon spatial light modulator at a sampling rate of 105 Hz.

In the third topic of this PhD thesis, we use CW light in NIR region for highly sensitive surface plasmon resonance (SPR) sensors. SPR sensors are powerful tools for optical sensing of refractive index (RI) and bio-molecules due to their high sensitivity. In this article, we demonstrate a beam-angle-scanning SPR system using a combined galvanometer mirror and relay lens optics. Use of a photodetector in the galvanometer mirror scanning of the incident beam angle enables both high precision and rapid data acquisition. RI resolution of 3.27×10^{-6} refractive index unit (RIU) and RI accuracy of 1.68×10^{-4} RIU were achieved at a data acquisition rate of 100 Hz. The results show the high potential of this beam-angle-scanning SPR system.