UNDERSTANDING POLARIZATION EFFECTS ON ABSORPTION SPECTRA MEASURED USING A QUANTUM CASCADE LASER-BASED SPECTROMETER

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Infrared (IR) spectroscopy using Quantum Cascade Lasers (QCLs) is an emerging technology that has opened new possibilities due to its numerous advantages such as shorter acquisition times and high signal-to-noise-ratio measurements. Furthermore, the intrinsic polarized source allows direct probing of other parameters, for instance, the dichroic properties of the samples. In particular, polarimetric detection can enhance structural and chemical contrasts and has been applied for imaging, chemical sensing, and biological tissue classification. While specific optical configurations are known to introduce polarization deviation and thus, less sensitivity in anisotropy detection, the influence on absorbance measurements has been downplayed as a systematic error. In this work, we characterize the polarization effects introduced by optical components. Using full-Stokes' measurements, we investigate the polarization scrambling and other effects introduced by various factors such as focusing optics, optical coatings, and incident source polarization. With this thorough analysis, we account for most of the polarization deviation factors introduced in typical experimental systems. Lastly, we optimize spectrometer design based on the characterization and demonstrate infrared absorbance spectra of polymer films with higher precision and anisotropy sensitivity.