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Optical Photothermal Interferometry Analysis

Interference-aware O-PTIR model extracts absolute film thickness and boosts SNR from substrate-supported samples using standard photothermal IR microscopes.

Researchers at Purdue University have developed a novel method to aid in interpreting reflection-based optical photothermal mid-infrared (O-PTIR) microscopy measurements of samples prepared on planar substrates. With existing instruments, such samples often experience optical interference in the back-reflected probe beam, which complicates conventional analysis methods. To address this need, Purdue researchers present this thin-film model for interpreting both the time-averaged (DC) reflectivity and the photothermally induced change in reflectivity (AC) from localized, transient heat deposition. In tests, this optical photothermal interferometry analysis (OPTIA) approach enabled recovery of the absolute thickness of individual bacterial colonies as well as large signal to noise enhancements in O-PTIR measurements. By utilizing a combination of higher overall reflectivity as well as enhancements in the contributions from optical interference between the sample and substrate, this method leverages interference effects rather than being hampered by them. This innovative approach has the potential to significantly increase the accessible information content in O-PTIR microscopy measurements and lays the foundation for additional measurement approaches.

Technology Validation:

This method was shown to enable recovery of the absolute thickness of individual Synechocystis colonies following transfer to IR transparent substrates. In addition, large signal to noise enhancements in O-PTIR measurements were both predicted and observed for measurements performed on silicon substrates relative to calcium fluoride, attributed to a combination of a higher overall reflectivity as well as enhancements in the contributions arising from optical interference between the sample and substrate responses.

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Category

Materials Science & Nanotechnology/Nanomaterials & Nanostructures
Materials Science & Nanotechnology/Materials Testing & Characterization Tools
Biotechnology & Life Sciences/Analytical & Diagnostic Instrumentation

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Advantages:

-Applicable to substrate-supported samples, a very common sample class

-Significantly increases the accessible information content in O-PTIR microscopy measurements

-Lays the foundation for additional innovative measurement approaches

-Can be integrated with existing commercially available photothermal infrared microscopy instruments

-Allows researchers to recover sample data that is otherwise unavailable using existing photothermal infrared microscopy technology

Applications:

Allows researchers using commercially available photothermal infrared microscopy instruments to interpret image contrast and use this information to recover absolute sample thickness, such as in chemical and some biological analysis.

Publications:

Manuscript submitted following an oral presentation at SPIE Photonics West meeting in San Francisco.

View the presentation abstract here: https://spie.org/photonics-west/presentation/Incoherent-microscopy-and-spectroscopy-of-biological-assemblies/13332-55

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Intellectual Property:

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