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## Preface

The energy levels of molecular vibrations are in the region of infrared radiation. Hence, FTIR spectroscopy is a powerful tool to analyze macromolecules in general, and proteins in particular. The information that such analyses yield pertains to the structure, dynamics and environment of the proteins under investigation. Sample requirements are in the sub-milligram levels (or smaller) and instrumentation costs are small relative to other spectroscopic tools. Since the infrared absorption of water overlaps that of proteins, FTIR spectroscopy is particularly suited to the study of proteins residing in membranes, fibrils and amyloid deposits. Finally, the long wavelength of infrared radiation (the main absorption of protein is around 6  $\mu\text{M}$ ) results in negligible scattering relative to UV/vis analyses of particulate samples.

The current issue covers the state of the art developments in infrared spectroscopy. Technical considerations of FTIR spectroscopy are covered by Manor and Arkin, focusing on advantages that isotopic labeling can provide. Furthermore, Harris describes the challenges that protein-protein interactions pose to the researcher and how difference spectroscopy and two-dimensional spectroscopy may be used to gain insight into such systems. Li and Yip describe recent advances in the field of scanned-probe, super-resolved IR spectroscopy and its application to the study of aggregates and membrane domains.

Two papers cover the field of monolayer examination: Heberle and coworkers describe surface-enhanced infrared absorption spectroscopy as a tool that can examine monolayers and their redox reactions. Blume and Kerth describe infrared reflection-absorption spectroscopy to examine monolayers at the air-water interface. Subsequently, two reviews examine the interactions of proteins with their membranous environment. Shai describes how ATR-FTIR can be used to examine how pore forming peptides interact with membranes. Axelsen and coworkers examine the interesting topic of

crowded microenvironments in which proteins may be found, such as reverse micelles.

Three studies provide a review on FTIR analysis of water-soluble proteins. Nara and coworkers examine  $\text{Ca}^{2+}$  binding protein by studying the carboxylate vibrations. Ruyschaert and coworkers discuss how ATR-FTIR can provide accurate and quantitative analysis on amyloid fiber formation, while Miller and coworkers show how aggregation can be monitored in living cells using infrared microscopy.

Finally, FTIR spectroscopy can also be used to examine lipid systems without proteins, as described by Lewis and McElhaney. In this review the authors show how lipid phase transition and non-lamellar structures can be examined by FTIR.



**Isaiah (Shy) Arkin** studied biology at the Hebrew University of Jerusalem and Tel Aviv University and obtained his PhD degree from Yale University. His major research interests are membrane protein structure and function, alongside development of tools to investigate them. His group uses experimental approaches, as well as computational tools to analyze the mechanism of membrane transport systems that regulate salinity and acidity of human pathogens. One example is using extensive computational simulations and experimental assays his group elucidated the mechanism of the main  $\text{Na}^+$  pump of bacteria. Similar efforts in his group uncovered novel mechanisms for drug resistance of the flu virus and potential ways to overcome it. Finally, his group

is well known for developing isotope edited FTIR spectroscopy in general, and the  $^{13}\text{C}_{\alpha=18}\text{O}$  probe in particular for structural studies of proteins.

Isaiah Arkin

E-mail address: [arkin@huji.ac.il](mailto:arkin@huji.ac.il).