PROTEIN STRUCTURE AND FUNCTION IN THE TIME-DOMAIN OF VIBRATIONAL SPECTROSCOPIES.

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A protein is characterized by more than 20000 vibrational degrees of freedom, the normal modes of vibration that may be correlated with internal coordinates such as bond lengths and bond angles. Because infrared light excites molecular vibrations the IR spectroscopy is a fundamental technique to investigate protein conformations and their dynamics. It was applied as early as in 1952 before any detailed X-ray results on proteins were available and nowadays, FTIR spectroscopy allows investigations of proteins in real physiological environments. Actually, because of the large number of normal modes, a vibrational spectrum is extremely complex with many vibrational bands overlapping so that the attempt of spectroscopists to understand from FTIR spectra the protein structure and function is really a hard task. However, in the last years, using FTIR micro-spectroscopy, many relevant results have been achieved in term of chemical imaging of living cells and investigations of cellular processes so that the future of this old spectroscopy is promising as ever.

This contribution deals with the most recent advancements of FTIR spectroscopy for the investigation of protein structure and function, which is now possible with unprecedent resolution in space and time by using intense synchrotron radiation sources. Moreover, the high source brilliance of the synchrotron radiation enables FTIR micro-spectroscopy to be performed within a few minutes at the resolution of just a few microns, a size scale appropriate for investigating individual living cells.