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***In situ* and *in vitro* characterization of biointerfaces using linear and non-linear optical spectroscopy** PATRICK KOELSCH, University Heidelberg and Karlsruhe Institute of Technology, OPTICAL SPECTROSCOPY TEAM — The actively emerging field of biointerfaces requires novel experimental techniques which allow us to deduce molecular-level based information under normal conditions and, in terms of biological relevance, in aqueous environments. In this contribution we demonstrate in several examples the feasibility of spectroscopic techniques to analyze complex structures at interfaces *ex situ*, *in situ* and *in vitro*: (i) DNA Films: We studied the chemical integrity, packing density, orientation, and ordering in monomolecular films of single-stranded DNA on Au by a combination of X-ray and IR spectroscopy. In addition, *in situ* broadband sum-frequency-generation (SFG) spectroscopy has been employed to determine the conformation and orientation of various homo-oligonucleotides in aqueous environments and to follow hybridization processes *in situ* on a molecular scale. (ii) Cell adhesion: We probed various cell types adhered on solid surfaces via *in vitro* broadband SFG spectroscopy to demonstrate the feasibility of using SFG spectroscopy as an experimental tool to characterize the extracellular matrix (ECM) layer adjacent to a solid substrate beneath a layer of cells. (iii) Membrane Proteins: Transmembrane proteins in Xenopus laevis oocytes and Zebrafish embryos have been studied by attenuated total reflectance infrared spectroscopy.

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