Infrared nanospectroscopy at SISSI: detecting DNA on clay nanotubes

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The SISSI beamline of Elettra Sincrotrone Trieste delivers light over a broad spectral range, from THz to visible. The laboratory represents a valuable tool in several research fields, spanning from biophysics and biology to cultural heritage and solid state physics. Exploiting the high brilliance of synchrotron light, SISSI (**S**ynchrotron **I**nfrared **S**ource for **S**pectroscopy and **I**maging) experimental end stations, SISSI-Bio and SISSI-Mat, offer the possibility to probe matter with diffraction limited lateral resolution of few microns in the mid-IR spectral range. The beamline capabilities have been further upgraded since the recent installation of the nano-FTIR (Neaspec) instrument. The nano-FTIR instrument, that exploits the radiation of DFG-IR lasers and whose coupling with the SR source is planned by the end of 2021, extendend indeed the IR lateral resolution up to 10-20 nm, allowing to circumvent diffraction limit. With nano-FTIR, infrared nanoresolved spectra are obtained by recording the infrared light scattered at a scanning probe tip. The probe is typically a conductive atomic force microscope (AFM) that, acting as an antenna, squeezes the incident field at the tip apex. When the tip is illuminated by the broadband infrared radiation, Fourier transform of the scattered light yields infrared spectra with a spatial resolution down to 10-20nm. Here we present the recent results we obtained at SISSI through nano-FTIR spectroscopy on the study of DNA adsorption on halloysite nanotubes. Halloysite nanotubes are natural nanosized tubular clay minerals that have many potential applications in different industrial fields. The focus of the research is on on the spontaneous adsorption of DNA molecules on nanotubes, process that can be exploited for the development of smart nano-carriers, suitable candidates for gene transfer. Our results show how nano-FTIR allows to depict the DNA-nanotube system in high detail, showing structural peculiarities of the adsorbed DNA molecules that were not detectable through far field spectroscopies and conventional microscopies.

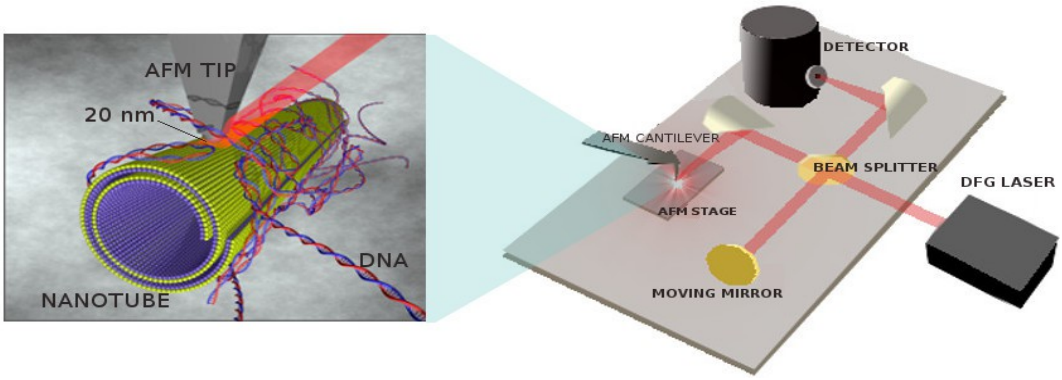

Figure – (Left): Graphical representation of DNA molecules wrapped around a clay nanotube. The AFM tip and the IR beam are also shown. (Right): Schema of nano-FTIR main components with laser optical path marked in red.