The FEL-based IR User Facility FELIX: A versatile source for infrared spectroscopy and studies on vibrational dynamics

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After a short introduction to the free electron laser, the characteristic features of the free electron laser and the facility will be discussed along with the implications for the kind of experiments that can be done at FELIX. In general, the experiments performed at FELIX cover a wide range of disciplines ranging from physics, chemistry, and material science to biology. Presently, the experiments fall predominantly in one of the following two classes: (i) relaxation phenomena in condensed matter and (ii) spectroscopy of gas-phase species, (bio)molecules and clusters either neutral or ionized.

Experiments of the first group will mostly use the low repetition rate or single pulse mode in view of the relaxation times involved. For those kinds of experiments two setups are available at the facility dedicated to measurements using four-wave mixing techniques as transient bleaching, transient grating and photon-echo. As examples of the first class of experiments studies will be presented on the relaxation of the stretch vibrations of hydrogen and deuterium in amorphous silicon and investigations on the vibrational lifetime of protein modes in the mid- and far-IR.

The second class of experiments is characterized by (very) low absorption of the sample and, because the detection scheme is based on dissociation or ionization of the species, typically a strongly nonlinear dependence on the laser fluence, implying the use of the high repetition mode of FELIX. For these experiments on gas-phase molecular systems, the two key requirements for the FEL are tunability and high fluence on the microsecond time scale. As examples of this class experiments investigations will be discussed on (a) the vibrational properties complexes of CO adsorbed on metal clusters and pure metal clusters, (b) vibrational spectroscopy of biomolecules and (c) studies using sophisticated ion trap machines i.e. a tandem mass-spectrometer and a Fourier Ion Cyclotron Resonance Mass Spectrometer.

As an outlook, a new project invoking the construction of building a new beam line at Rijnhuizen called 'FELICE' dedicated to intracavity experiments will be introduced.