PLEIADES: an ultra-high resolution soft x-ray beamline for spectroscopy of dilute species

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Synopsis The soft x-ray beamline PLEIADES at synchrotron SOLEIL is dedicated to high-resolution spectroscopic studies of various dilute matter species: ions, atoms, molecules, clusters, biomolecules, nanoparticles and liquids. The beamline uses one of two in-line undulators to cover the photon energy range 9-1000eV with variable linear and circular polarizations. A variety of end-stations are permanently available at the beamline including a high resolution electron spectrometer, a merged ion-beam apparatus and an electron-ion coincidence spectrometer optimized to measure high kinetic energy electrons in coincidence with ion momenta.

The synchrotron beamline PLEAIDES at the French national synchrotron SOLEIL has been in operation for several years. Recent publications demonstrate its unique suitability for studies of dilute species in high-resolution electron spectroscopy of atoms [1], molecules [2] and clusters [3], spectroscopy of atomic [4] and molecular ions [5], biomolecules [6], nanoparticles [7] and for coincidence measurements [8].

Two insertion devices, a 256mm period electromagnetic undulator for photon energies below 100eV, and a 80mm period permanent magnet APPLE-II type undulator for energies above 60eV provide photons from 9-1000eV with variable linear and circular polarization. A varied line spacing plane grating monochromator with four varied line depth gratings provides high resolution while maintaining high flux owing to the high efficiency of the gratings. The beam is focused to one of five different experiment locations, three of which have permanently installed end-stations, while the two others are open ports available for the installation of user-supplied apparatus.

The MAIA merged beam setup for photoion and photoelectron studies of ionic species occupies one of the locations [9]. Ions produced in an electron cyclotron resonance (ECR) ion source, or other sources as needed, are mass-to-charge (m/q) ratio selected and steered to be overlapped with the photon beam. Changes in charge state are monitored by demerging the ion beam and again dispersing it by its m/q ratio. The ability to measure photoelectrons in coincidence with the ions has also recently been implemented [4].

A novel electron-ion coincidence spectrometer using a double-toroidal (DTA) electron energy analyzer and a momentum resolving ion spectrometer, dubbed EPICEA [10], occupies another of the beamlines focus points. The DTA analyzer measures high kinetic energy electrons in coincidence with the resulting ions and does not require special timing mode operation of the ring to obtain coincidence spectra.

A 200mm VG-Scienta R4000 electron spectrometer is at the heart of the third permanently installed end-station on the beamline. This versatile instrument can be equipped with a variety of different sample environments including a gas cell for volatile samples, a supersonic jet for cooling or clustering, a planar (Doppler-free) jet, an aerodynamic lens for nanoparticles and a liquid jet apparatus from Microliquids GmbH for studies of liquid phase samples.

References

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