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Vacuum Ultraviolet Luminescence Spectroscopy Setup at Max IV Laboratory

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The MAX IV Laboratory (Lund, Sweden) is a new synchrotron radiation research center located in Lund Sweden. It was inaugurated in June 2016. Currently, seven beamlines have been installed at the MAX IV facility. With a circumference of 96 m and an electron energy of 1.5 GeV, the new storage ring at MAX IV Laboratory is a perfect synchrotron source for VUV and soft x-ray (XUV) photon generation. Time-resolved luminescence experiments will be performed in one of the branches of the FinEstBeaMS beamline, which is developed by a consortium of Finnish and Estonian Universities.

The tuneability of synchrotron radiation and its inherent well-defined time structure makes it particularly well suited for time-resolved luminescence studies. The state of art of such investigations is summarized in the review of SUPERLUMI setup [1], which was a flagship for three decades. Particularly, it is proven that time-resolved vacuum ultraviolet (VUV) luminescence excitation spectroscopy under synchrotron radiation is a powerful tool for the study of electronic structure of any classes of wide band gap luminescent and scintillating materials.

The FinEstBeaMS will use an elliptically polarizing undulator light source, which produces soft x-rays of a variable polarizations with high flux 8x1013 ph/s –1x1011 ph/s at photon energies between 4 and 1000 eV. Higher order excitation will be prohibited using either solid state (MgF2, SiO2, metal films) filters or gas phase filter in future. The duration of synchrotron pulses is 200 ps.

The luminescence endstation consisting of an ultra-high vacuum chamber with a closed-cycle helium cryogenic system was constructed providing sample temperatures T = 4 –400 K. To analyze photoluminescence in the UV to near IR range a Shamrock 0.3 m spectrometer equipped with a CCD and several time-resolved photomultiplier detectors is coupled to an optical fiber, collecting emission from the sample. Time-resolved luminescence spectroscopy experiments can be implemented in single bunch mode of storage ring and/or utilize a chopper. The single bunch mode provides 320 ns time window to perform time-resolved experiments, while a chopper can extend a time window up to microseconds range. The possibility to use high-resolution excitation (0.01 nm at 100 nm) in scanning mode and the option of tuneable polarization of the incident light, not widely used so far, make this beamline very attractive for the field of luminescence and scintillating studies under VUV and XUV excitations.

[1] G. Zimmerer., Radition Measurements 42, 2007, 859

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