Advances on the Toroidal Grating Monochromator (TGM) Beamline at Laboratório Nacional de Luz Síncrotron (LNLS): A Harmonic Filter

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We report on an important advance for the low energy vacuum ultraviolet TGM beamline at LNLS. In the case of bending magnet sources, as well as in the case of state of art insertion devices such as undulators, the output grating selected radiation frequency ω generally comes out with a series of harmonics, that is, 2ω, 3ω and so on. The fundamental radiation and its harmonics are superimposed on the diffracted beam emerging from the exit slit, due to the nonzero higher order grating transmission. In ion as well as in electron spectroscopy studies performed with this "monochromatic" radiation, the presence of harmonics can be a real problem since the signal they generate can hide or even overwhelm the signal produce by the fundamental radiation. In order to overcome this problem we analyzed several strategies, such as the use of metallic thin films, a set of plane mirrors placed at variable grazing incidence and absorption through gas phase regions. For the fundamental energy range from 12 to 21 eV it turns out that the gas filter is the best choice. However, a very low partial pressure of the filling rare gases is allowed in the storage ring, in this way requiring a really intricate system of differential pumping to isolate the gas region (at mbar pressures) from the ultra-high vacuum regions of the monochromator and the storage ring. We decided for a mixed setup which consists basically in filling a region of the beamline with a rare gas and isolating this region from the rest of the vacuum system with two metallic thin filters placed on gate valves. In the first tests, performing time of flight spectroscopy of Argon, this filter working with pressures of some 10^{-1} mbar of Neon was sufficient to completely wash out the high harmonics contributions in the spectrum. In other experiment, performing photo-electron spectroscopy in a metallic sample of Ni irradiated at 19 eV, it was possible to observe the filter efficiency up to the 10th harmonic. One problem of this setup is the unexpected 1st harmonic low transmittance of the metallic filters, used basically as physical barriers. Even with this prototype version of the TGM gas filter, it will be possible to perform several experiments not feasible so far.