Damage analysis of EUV Mo/Si multilayer coating irradiated by IR femtosecond pulses

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A standard Mo/Si multilayer coating, designed to reflect EUV attosecond pulses, has been exposed to the intense femtosecond IR radiation at the ULTRAS laboratory (Milan). The multilayer coatings for attosecond sources are not usually exposed to high thermal load since are protected by metallic filters interposed between the point of high harmonic generation and the multilayer coating. The purpose is to reject the high energy load of the fundamental and low order harmonics. However, since the filters are free standing thin films of zirconium or aluminum, depending on the spectral region, they are relatively unstable and can be easily broken by the obsolescence of the materials or by accidental shock, consequently, the multilayer optics can be exposed to IR intense Ultrashort radiations. This work investigates the damage of Mo/Si optics, designed for attosecond pulses, when they are exposed to ultra-short and ultra-intense infrared pulses. Different points of the sample have been exposed to pulses with different parameters, according to the following groups:

1) first group: same exposure time (60 seconds), different pulse energy (0, 40, 130 and 330 μJ)
2) second group: same pulse energy (330 μJ) with different exposure time (0, 10, 100, 500, 1000, 5000, 10000 and 60000 ms) that considering a frequency repetition of 1 KHz correspond to different number of pulses that impinge the sample (0, 10, 100, 500, 1000, 5000, 10000 and 60000 pulses).

Results of the experiment will be shown and discussed. In particular, the performances of the multilayer, phase and reflectivity behavior, before and after the irradiation in order to understand the degradation induced by the intense fields have been measured. The phase behavior has been investigated using an method based on Total Electron Yields data. In addition the exposed surface morphology and composition have been investigated using respectively a profilometer and XPS spectroscopic technique.