DAMAGE STUDIES TO MULTILAYER MIRRORS BY INTENSE SOFT X-RAY BURSTS

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In the context of the MegaJoule project in France, the use of multilayer mirrors are planned to select the soft part of the x-ray spectrum (below 10 keV). The hard x-ray part (from 10 keV to 100 keV) produced by a Bremsstrahlung process go through the mirror while the soft x-rays will be reflected by the multilayer mirrors towards the diagnostic chamber. The expected fluence on the multilayer is in the order of 4 J/cm2 while the damage thresholds reported in the litterature are well below 0.5 J/cm2.

In this work we measure the dynamical Bragg reflectivity of different x-ray multilayer mirrors when they are submitted to intense and short soft x-ray bursts. We use the Heliotrope facility at the CEN. Two laser plasma emissions irradiate simultaneously the multilayer mirror: the first one from a NaCl target emitting a heliumlike emission line (1.3 keV) is used to probe the multilayer reflectivity while a second one from a gold target is used to heat the multilayer structure with a continuous spectrum ranging from 100 eV to 1 keV. The time evolution of the multilayer reflection is recorded by a streak-camera with a time resolution of 20 ps. We also tentatively simulate the phenomena. We consider the energy deposition within the bulk of the multilayer structure; a thermomechanical code, taking into account the thermal conductivity of the material components, calculates the mechanical behavior of the stratified structure during the irradiation by the soft x-rays. The corresponding time evolution of the multilayer structure is then introduced in a reflectivity code to give the dynamical reflectivity of the multilayer mirror.