Amplified spontaneous and stimulated Mg *L* emissions from MgO pumped by FEL pulses

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A MgO target has been irradiated by 65 fs/56.8 eV XFEL single pulses delivered by the EIS-TIMEX beamline at the FERMI facility. The radiation emitted in the Mg *L* spectral range has been recorded by an avalanche photodiode coupled to a filter to reject the long wavelength radiations and the FEL exciting radiation. The emitted radiation intensity has been measured versus the take-off angle β at the maximum available XFEL pump intensity, 6 x 10^{14} W/cm^{-2}. This angular distribution presents a maximum around 52° corresponding to a privileged direction given by the balance between the absorption length of the pumping radiation and the interaction length of the emitted radiation. The emitted radiation intensity has been also recorded versus the XFEL pump intensity with the detector located at β = 52°. One observes as the pump intensity grows, first a slowly increasing plateau up to a threshold value about 4.3 x 10^{14} W cm^{-2} and then a large enhancement from this threshold value. This behaviour is typical of the travelling wave amplified spontaneous emission with a clamping of the gain at the pumping threshold for the stimulated emission. Calculations performed with a hydrodynamic code indicate that the electron temperature of the sample is close to 10 eV, which means that the sample is then in a dense plasma state. A phenomenological model based on rate and transport coupled equations has been developed to account for the experimental results. The theory reproduces both angular distribution and evolution of the emitted intensity as a function of the pump intensity.