# THEORETICAL AND EXPERIMENTAL STUDIES ON MOLIBDENIUM AND STAINLESS STEEL MIRRORS CLEANING BY HIGH REPETITION RATE LASER BEAM

A. Leontyev[1], A. Semerok[1], D. Farcage[1], P.-Y. Thro[1], Ch. Grisolia[2], A. Widdowson[3], P. Coad[3], M. Rubel[4] and JET-EFDA Contributors[#]

[1]*CEA-Saclay, DPC/SCP/LILM, F-91191 Gif-sur-Yvette, France*
[2]*CEA-Cadarache, IRFM, F-13108 St Paul Lez Durance, France*
[3]*Culham Science Centre, Abingdon, Oxon, OX14 3DB, UK*
[4]*Alfvén Laboratory, Royal Institute of Technology, 100 44 Stockholm, Sweden*

*Corresponding author: anton.leontyev@cea.fr*

The general aim of our studies was to determine the damage threshold of molybdenum (Mo) and stainless steel (SS) mirrors. In our study, it was anticipated that the laser beam would provide the maximum fluence that the mirror surfaces could withstand without affecting the reflectivity properties. A high repetition rate Nd-YAG laser (20 kHz, 1.06 μm, 120 ns) was applied. The experimental one-pulse (2.3 J/cm$^2$ for SS and 6.5 J/cm$^2$ for Mo) and multi-pulse (1.4 J/cm$^2$ for SS and 3.1 J/cm$^2$ for Mo) heating damage thresholds were obtained.

The 3D analytical model was developed to estimate the surface temperature increase resulting from the pulsed repetition rate laser heating of metal samples. The analytical solution results and those obtained with the numerical simulation were in a good agreement. Thus, the analytical model may be regarded suitable for rapid calculation of surface temperature after repetitive pulsed laser heating.

The analytical model was complemented by the models where the temperature dependent absorptance and multiple pulse damage based on plastic deformations accumulation were taken into account. The experimental one-pulse and multi-pulse heating damage thresholds were in a good agreement with the theoretical ones. Thus, our models are applicable for an adequate description of a high repetition laser heating and metal mirrors damaging.

The experimental results on damage thresholds of the mirrors and the developed models of laser heating may be applied to choose an optimal laser cleaning regime and to avoid mirrors damage.

[#] *See the Appendix of F. Romanelli et al., Proceedings of the 22nd IAEA Fusion Energy Conference 2008, Geneva, Switzerland*