Powerful laser pulse absorption and energy transport in laser-produced plasma of low dense porous substances

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Powerful laser pulse interaction with porous materials of light elements is one of the interesting and actual topics in high-temperature plasma physics. The internal structure of these materials determines the features of laser absorption and the characteristics of relaxation and transport processes in the laser-produced plasma [1, 2]. The use of a low-density foam in the outer layer of a spherical fusion capsule as an absorber can rapidly smooth the spatial laser inhomogeneities and improve laser-target coupling efficiency. When the foam has a density larger than the critical plasma density for the given laser wavelength, the pressure in the laser produced plasma exceeds the pressure obtained by direct irradiation on a solid homogeneous target [3].
In this work, laser absorption in porous material is investigated on the base of one-dimensional simulations using a modified version of the code MULTI [4]. The delayed absorption described in [5] as well as the constraints on the electron conductivity and on the pressure due to the homogenization process have been implemented in the code to reproduce the expected behavior of the plasma. The features of laser energy deposition, as well as temporal-space evolution of laser-produced plasma density, temperature, pressure for subcritical and overcritical foams with small-size and large-size structures obtained in the simulations are discussed. The differences between the properties of laser-produced plasmas of a porous and a homogeneous target with the same average density are highlighted. The results are compared with the recent experiments performed at ENEA-ABC facility.[1]

References

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