Ablation of tantalum and vanadium: Strength of liquid phase under a single-pulse action of femtosecond laser

Struleva E V[@], Ashitkov S I, Komarov P S, Ovchinnikov A V and Agranat M B

Joint Institute for High Temperatures of the Russian Academy of Sciences, Izhorskaya 13 Bldg 2, Moscow 125412, Russia

[@] struleva.evgenia@yandex.ru

Femtosecond laser interactions with metals are described by the two temperature model [1]. Rapid isochoric heating and nonequilibrium bulk melting of a surface layer on a picosecond timescale are accompanied by the development of cavitation processes in the melt rarefaction wave and ablation of some melt in the form of a thin spall plate in a condensed state [2]. Ablation of tantalum has a bright specificity due to its high mechanical strength and low thermal conductivity. In this paper we study the ablation spall of tantalum and vanadium. An interferometric method is realized using a frequency-modulated pulse for diagnosing a dynamics of fast deformations with a spatial and temporal resolution under the action of a single laser pulse. Using an interferometric continuous monitoring technique [3], we have investigated the motion of the surface of a tantalum and vanadium targets in the case of femtosecond laser ablation near the threshold at picosecond time delays relative to the instant of laser exposure. The tensile strength of heated metals in a condensed state has been determined experimentally at an expansion rate of $\sim 10^9$ s^{-1}.

[1] Anisimov S I, Kapeliovich B L and Perel'man T L 1974 *Zh. Eksp. Teor. Fiz.* **66** 776

[2] Inogamov N A, Petrov Y V, Khokhlov V A, Anisimov S I *et al* 2014 *J. Opt. Tech.* **81** 233

[3] Whitley V H, McGrane S D, Eakins D E *et al* 2011 *Appl. Phys.* **109**