On effectiveness of characteristic X-rays generation under vacuum heating of hot electrons by a femtosecond laser pulse

O.F. Kostenko, N.E. Andreev

Joint Institute for High Temperatures RAS, Moscow, Russia, [olegkost@ihed.ras.ru](mailto:olegkost@ihed.ras.ru)

Enhancement of characteristic X-rays yield from a substrate was revealed under irradiation of various nanostructures by femtosecond laser pulses of non-relativistic intensities. Modeling, that takes into account increase of electric field, accelerating hot electrons at the surface of spherical clusters according to the vacuum heating mechanism, demonstrated strong dependence of *Kα* yield on the cluster size [1].

The models of *Kα* photons generation [2] and hot electron temperature [3] under vacuum heating of hot electrons by a femtosecond laser pulse on the surfaces of a flat massive target and the target covered with spherical clusters are developed in present paper. The model of *Kα* photons generation takes into account energy losses of hot electrons in a solid target, energy dependent cross section of *K*-shell impact ionization, probability of *Kα* photons emission by excited atoms and attenuation length of the emitted X-rays. Dependences of hot electron temperatureand *Kα* yield from a silicon target, covered with spherical clusters, on cluster size in cases of *p*-polarized and normally incident laser pulses are in agreement with the measurements [4].

It is demonstrated that strong decrease (by two orders) of effectiveness of *Kα* photons generation under irradiation of massive silicon target by short wavelength (0.4 μm) *p*-polarized laser pulse [4] in comparison with the experiment with irradiation of an iron target by long wavelength (1.24 μm) pulse with close parameters [5] is related to reduction of hot electron vacuum heating.

References

1. Kostenko O.F., Andreev N.E*. Phys. Scr.* (2010) **81** 055505.
2. Kostenko O.F., Andreev N.E. *Quantum Electronics* (2013) **43** 237.
3. Kostenko O.F. et al. *Phys. Scr.* (submitted).
4. Sumeruk H.A. et al. *Phys. Rev. Lett.* (2007) **98** 045001.
5. Agranat M.B. et al. *JETP Lett.* (2006) **83** 72.