Molecular dynamics simulation of hypervelocity impacts; W on W.

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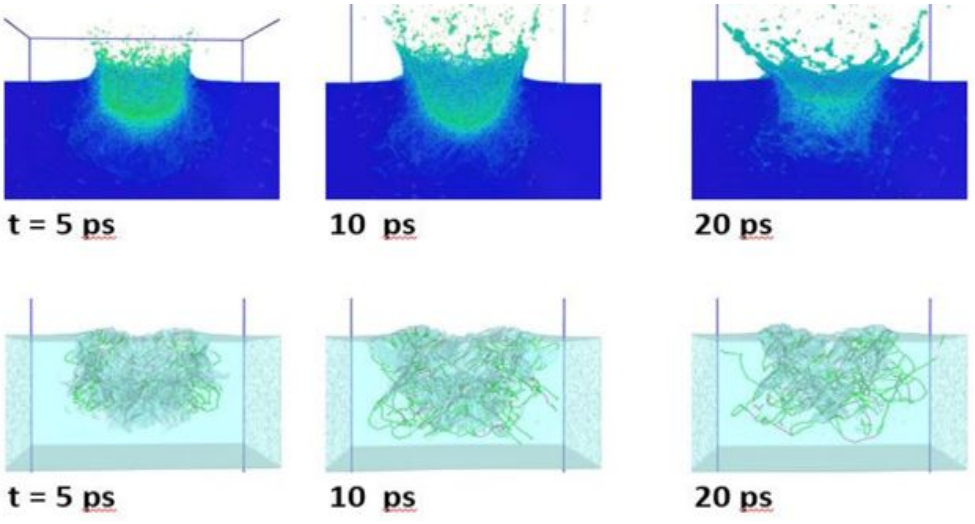
Plasma-material interactions are a key issue in the realization of practical fusion power reactors, which is recognized since the beginning of magnetic fusion research [1]. Controlling plasma-wall interactions is critical to achieving high performance in present day tokamaks. Tungsten (W) is the main candidate as plasma facing components for a fusion reactor and will be exclusively used in the ITER divertor [1]. The presence of high velocity impacts has been reported in several studies, with velocities being around 500 m/s to a few km/s [2].

In this work, the atomistic mechanisms of damage initiation during high velocity (v up to 9 km/s) impact of W projectiles on W has been investigated using molecular-dynamics simulations involving very large samples (up to 40 million atoms). Various aspects of the impact at high velocities where the projectile and part of the target materials undergo massive plastic deformation, breakup, melting or vaporization are analyzed. Different stages of the penetration process are identified. Whether the damage occurring in the subsurface of the target is described by collision cascades or as the effect of shock waves will be discussed.



High velocity impact (5 km/s) of a 40 nm-size W cluster on a W single crystal target, at times 5, 10 and 20 ps

References

[1] G. Federici, C. H. Skinner et al, Nucl. Fusion 41, 1967 (2001).

[2] C. Castaldo, S. Ratynskaia et al, Nucl. Fusion 47, L5–9 (2007).