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The MD simulation on the micro-mechanism of micro-spallation of metal Pb under shock loading JUN CHEN, MEIZHEN XIANG, Laboratory of Computational Physics, Institute of Applied Physics and Computational Mathematics, HAIBO HU, CAEP — We study the micro-mechanism of crystal and nano-crystal metal Pb under shock loading by using the molecular dynamics method. A wide range of shock intensity is conducted with the lowest one just above the threshold of solid spallation, while the highest one higher than the threshold of shock melting. The spallation mechanism is dominated by cavitation, i.e., nucleation, growth and coalescence of voids, as well as the interplay of cavitation and melting. Our results discovered that the grain boundary plays an important effect in the case of releasing melting, while it is smaller effect on the cases of conventional spallation and shock melting. The cavitation and melting firstly form in the grain boundary, and they display mutual promotion: melting makes the void nucleation at smaller tensile stress; void growth speeds the melting. The spall strength dependence on the grain boundary, void and melting temperature is qualitatively discussed. Due to grain boundary effects, the spall strength of nano-crystalline Pb is less sensitive to shock intensity than single-crystalline Pb if cavitation occurs in solid state materials. If melting starts before cavitation, the spall strength of both nano-crystalline and single-crystalline Pb decreases dramatically as shock intensity increases.

Jun Chen
Laboratory of Computational Physics,
Institute of Applied Physics and Computational Mathematics

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