Two Level Investigation of Plasticity Driven Growth of Nanovoids Under High Rate Tension of Aluminum

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ABSTRACT

With help of molecular dynamic simulations [1] the mechanism of nanovoid growth in aluminum under high rate tension was studied. We interpret the growth of nanovoids as the result of plastic deformation in zone close to void and corresponding atom rearrangement on void surface. The dependencies of critical negative pressure in systems of various atom number and void diameter at various temperatures was researched. It was shown, that critical pressure depends both on void diameter and simulated area size. Increase of temperature leads to linear decrease of system tensile strength.

The continual model connecting void growth rate with dislocation processes occurring around void. The generation of dislocations near void surface is described with Arrhenius type relation, the parameters of this formula (energy of dislocation nucleation and activation volume) are fitted by comparison with molecular dynamic data. Fitted value of activation volume is close to case of homogeneous dislocation formation in pure aluminum and value of nucleation energy is lower than one reported in work [2]. When material deforms at rate of $10^7 \div 10^8$ s^{-1}, the initial dislocation density is enough for effective void growth, for grater deformation rates the dislocations nucleate near void surface.

REFERENCES

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