Accepted Manuscript

Influences of nanotwin volume fraction on the ballistic performance of coarse-grained metals

Q.D. Ouyang, G.J. Weng, A.K. Soh, X. Guo

PII: S2095-0349(17)30110-1
DOI: https://doi.org/10.1016/j.taml.2017.09.012
Reference: TAML 187

To appear in: *Theoretical & Applied Mechanics Letters*

Received date : 29 June 2017
Revised date : 26 September 2017
Accepted date : 27 September 2017

Please cite this article as: Q.D. Ouyang, G.J. Weng, A.K. Soh, X. Guo, Influences of nanotwin volume fraction on the ballistic performance of coarse-grained metals, *Theoretical & Applied Mechanics Letters* (2017), https://doi.org/10.1016/j.taml.2017.09.012

Influences of nanotwin volume fraction on the ballistic performance of coarse-grained metals

Q.D. Ouyang[a,b], G. J. Weng[c], A.K. Soh[d], X. Guo[a,b,*]

[a] *School of Mechanical Engineering, Tianjin University, Tianjin 300072, China*

[b] *Tianjin Key Laboratory of Nonlinear Dynamics and Chaos Control, Tianjin 300072, China*

[c] *Department of Mechanical and Aerospace Engineering, Rutgers University, New Brunswick, NJ 08903, USA*

[d] *School of Engineering, Monash University Malaysia, Bandar Sunway, Salangor, Malaysia*

Highlights:

1. Numerical model adopts strain gradient plasticity and Johnson–Cook failure criterion.
2. Ballistic performance is quantified by limit velocity and limit displacement.
3. Small twin spacing (d_{TW}) and moderate volume fraction of nanotwin (f) are better.
4. Indirect effects of f arise from d_{TW} and shape and distribution of microstructures.
5. Limit displacement among different f depends on category of impact processes.

Abstract Coarse-grained (CG) metals strengthened by nanotwinned (NT) regions possess high strength and good ductility. As such, they are very suitable for applications in bullet–proof targets. Here, a numerical model based on the conventional theory of strain gradient plasticity and the Johnson–Cook failure criterion is employed to study the influences of volume fraction of NT regions on their ballistic performance. The results show that in general a relatively small twin spacing (4–10 nm) and a moderate volume fraction (7%–20%) will lead to excellent limit velocity and that the influences of volume fraction on limit displacement changes with the category of impact processes.

Keywords: Nanotwin; Ballistic performance; Volume fraction; Limit velocity; Limit displacement.

Target-plate materials with excellent ballistic performance are highly demanded in military fields. A new category of materials, the nanotwinned (NT)-strengthened

* Corresponding author.
E-mail address: xiangguo@tju.edu.cn (X. Guo).