

FINITE ELEMENT ANALYSIS ON HOT DEFORMATION BEHAVIOR OF TiC-PARTICLE-REINFORCED TITANIUM MATRIX COMPOSITES

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Key Words: *Titanium matrix composite, Finite element, Fixed point iteration, Numerical simulation, Tensile property.*

Particle-reinforced titanium matrix composites (PRTMC), one kind of metal matrix composites, consist of high-performance reinforced phase and Titanium alloy matrix. Because of their higher stiffness-to-weight ratio, strength-to-weight and good high-temperature properties, these composites are widely used in the fields of aerospace, nuclear industry, oil and medical industry. At the same time, it can be easily processed into complex shaped parts, which will reduce the waste and the loss in machine processing. PRTMC have excellent secondarily processed performance and can be used as structure materials in the condition of high temperature, high pressure, acid, alkali and salt. PRTMC are considered as suitable materials for a new generation engine. Because TiC particle, a kind of ceramic particle, is compatible to titanium and titanium alloy in thermodynamics and the density, the expansion coefficient, the Poisson's ratio of TiC is similar to that of the titanium, TiC becomes the major reinforcing material in particle-reinforced titanium matrix composites.

In the current paper, the tensile properties of TiC particle reinforced titanium matrix composite were investigated by using elasto-plastic finite element programs and homogenization method. Two quasi-static and dynamic transient programs of elasto-plastic finite element were coded by using FORTRAN. Based on the finite element programs, the finite element model of the TiC particle reinforced titanium matrix composites with typical microstructures was established by using fixed point iteration method and homogenization theory. The hot deformation behavior of TiC particle reinforced titanium matrix composites under different temperatures and strain rates were analyzed by using the above model and programs. Based on the experimental data, a good agreement was obtained between the numerical predictions and the experimental results, and the feasibility of this method was verified.

REFERENCES

- [1] D. R. J. Owen, and E. Hilton, *Finite elements in plasticity: Theory and practice*, Pineridge Press Limited Swansea, 1980.
- [2] J. Tirosh, W. Nachlis, and D. Hunston, Strength behavior of toughened polymers by fibrous (or particulate) elastomers, *Mech. Mater.*, Vol. **19**, pp. 329-342, 1995.