

料的细观变形破坏机理很重要。

4 结束语

本文在准静态间接拉伸和蠕变实验研究的基础上对 PBX 炸药的力学行为和变形破坏机理进行了一些分析和讨论。研究 PBX 的力学行为和变形破坏机理还需要开展很多工作,这包括深入研究单相材料(炸药和粘结剂)的力学性质,对材料的微观结构和细观力学现象进行分析;建立 PBX 材料的细观力学模型,研究在不同应变率和温度下材料的力学性质。

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参考文献:

- [1] Nicholson D W. On the detachment of rigid inclusion from an elastic matrix[J]. *J. Adhesion*, 1979, 10: 255 - 260.
- [2] Gent A N, Park B. Failure processes in elastomers at or near a rigid spherical inclusion [J]. *J. Mater. Sci.*, 1984, 19: 1947 - 1956.
- [3] Palmer S J P, Field J E. The deformation and fracture of β -HMX[J]. *Proc. R. Soc. Lond. A.*, 1982, 383: 399 - 407.
- [4] Palmer S J P, Field J E, Huntley J M. Deformation, strengths and strains to failure of polymer bonded explosives[J]. *Proc. R. Soc. Lond. A.*, 1993, 440: 399 - 419.
- [5] Seaman L, Simons J W, Erlich D C. Development of a viscous internal damage model for energetic materials based on the BFRAC T microfracture model[A]. 11th In-

ternational Detonation Symposium [C], Snowmass, Colorado(USA), 1998.

- [6] Field J E, Parry M A, Palmer S J P, et al. Deformation and explosive properties HMX powders and polymer bonded explosives[A]. Ninth Symposium(International) on Detonation[C], Portland, Oregon(USA), 1989.
- [7] Skidmore C B, Phillips D S, Howe P M. The evolution of microstructural changes in pressed HMX explosives[A]. 11th International Detonation Symposium [C], Snowmass, Colorado(USA), 1998.
- [8] Rae P J, Goldrein H T, Palmer S J P, et al. Studies of the failure mechanisms of polymer-bonded explosives by high resolution moire interferometry and environmental scanning electron microscopy[A]. 11th International Detonation Symposium [C], Snowmass, Colorado (USA), 1998.
- [9] Wiegand D A. Mechanical properties and mechanical failure of plastic bonded explosives and other energetic materials[A]. 11th International Detonation Symposium [C], Snowmass, Co-lorado(USA), 1998.
- [10] Gray G T, Idar D J, Blumenthal W R, et al. High- and low- strain rate compression properties of several energetic material composites as a function of strain rate and temperature [A]. 11th International Detonation Symposium [C], Snowmass, Co-lorado(USA), 1998.
- [11] Cho K, Gent A N. Cavitation in model elastomeric composites[J]. *J. Mater. Sci.*, 1977, 12: 1055 - 1058.
- [12] Gent A N, Lindley P M. [J]. *Proc. R. Soc. Lond. A.*, 1959, 249: 195 - 205.
- [13] Mueller H K, Knauss W G. [J]. *Trans. Soc. Rheology*, 1971, 15: 217 - 233.

Mechanical Behaviour and Deformation and Failure Mechanisms of Polymer Bonded Explosives

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Abstract: The micromechanical phenomena and deformation and failure mechanisms of PBXs are discussed based on the experimental studies of a certain PBX material. PBX material has several kinds of failure phenomena. Interface debonding and matrix cavitation are the predominant failure mechanisms.

Key words: polymer bonded explosives, mechanical behaviour, deformation and failure mechanism