

Numerical Simulation of the Interior Ballistic Performance for Partially Cut Multi-perforated Stick Propellants

ZHAO Yu-hua, YANG Wei-tao, YAN Wen-rong, ZHANG Jiang-bo, XIAO Xia

(Xi'an Modern Chemistry Research Institute, Xi'an 710065, China)

Abstract: To study the interior ballistic performance of charge for partially cut multi-perforated stick propellant, a interior ballistic simulation model of charge for partially cut multi-perforated stick propellant was established based on the classical interior ballistic theory. The calculation of interior ballistic performance of charge was performed using the partially cut multi-perforated stick propellant with high energy nitramine propellant formulations. The experimental validation were carried out on 30 mm artillery. The effect of incision intervals, incision web and incision depth on the interior ballistic performance of partially cut multi-perforated stick propellant was analyzed. The results show that the maximum bore pressure calculated by the established interior ballistic model of partially cut multi-perforated stick propellant is 430.2 MPa. The calculated error of the maximum bore pressure is 5.0% compared with average value of testing maximum bore pressure of 409.7 MPa. The calculated muzzle velocity is $1378.2 \text{ m} \cdot \text{s}^{-1}$, and the calculated error is 2.2% compared with average value of testing muzzle velocity of $1409.6 \text{ m} \cdot \text{s}^{-1}$. The maximum bore pressure and muzzle velocity decrease with the increase of incision intervals. When the incision intervals increase from 5 mm to 50 mm, the maximum bore pressure reduces by 12.0%. And the muzzle velocity reduces by 3.1%. The effect upon the interior ballistic performance is gradually reduced when the numerical value of incision intervals is greater than 20 mm. The value of maximum bore pressure and muzzle velocity increases with the increase of incision depth and incision web. The effect of incision depth upon the maximum bore pressure is more significant than that upon the muzzle velocity. The interior ballistic performance of the propellant is insensitive to the change of incision web's value.

Key words: propellant charge; closed-bomb test; partially cut multi-perforated stick propellant; interior ballistic model

CLC number: TJ55

Document code: A

DOI: 10.11943/CJEM2018265

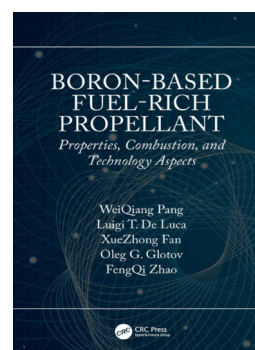
(责编:高毅)



新书介绍——《含硼富燃料推进剂:特性、燃烧及应用技术》

《BORON-BASED FUEL-RICH PROPELLANT: Properties, Combustion, and Technology Aspects》(中文译名:《含硼富燃料推进剂:特性、燃烧及应用技术》)于2019年5月正式发行。本书由庞维强、Luigi T. De Luca、樊学忠、Oleg G. Glotov、赵凤起合作撰写, Taylor & Francis Group, CRC Press资助出版。该书全面论述了无定形硼粉的表面改性及团聚,分章研究了团聚改性前后硼粉对富燃料推进剂流变性能、能量性能、燃烧性能等的影响,展望了含硼富燃料推进剂未来的发展趋势。

本书是含硼富燃料推进研究领域的最新国际论著,可作为高等院校相关专业研究生的教材或参考书,也可供从事含能材料、固体推进剂、火炸药和军事烟火技术研究、生产、使用和管理的有关科研人员、工程技术人员参考。



西安近代化学研究所 庞维强研究员供稿