陈雄,钮然铭,郑健,贾登.率相关HTPB推进剂/衬层界面Ⅱ型内聚力模型[J].航空动力学报,2015,30(11):2787~2793

率相关HTPB推进剂/衬层界面Ⅱ型内聚力模型

Rate-dependent cohesive zone model of the interface between HTPB propellant and insulation

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中文关键词: 内聚力模型 推进剂/衬层界面 脱黏 率相关内聚力模型 损伤函数

英文关键词:cohesive zone model propellant and insulation interface debonding rate-dependent cohesive zone model damage function

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作者	单位
陈雄	南京理工大学 机械工程学院, 南京 210094
钮然铭	南京理工大学 机械工程学院, 南京 210094
郑健	南京理工大学 机械工程学院, 南京 210094
贾登	南京理工大学 机械工程学院, 南京 210094

中文摘要:

采用实验与反演相结合的方法构建了端羟基聚丁二烯(HTPB)推进剂/衬层界面的率相关的内聚力模型.采用改进的单搭接试件完成了HTPB推进剂/衬层界面的断裂实验研究,采用内聚力单元方法对单搭接试件进行了数值研究,结合基于Hook-Jeeves优化算法的反演识别程序,获取了不同加载率下的界面断裂参数.由于界面断裂参数具有明显的率相关性,通过构建率相关的损伤函数,构建了基于双线性内聚力模型的率相关HTPB推进剂/衬层界面Ⅱ型内聚力模型.模型预测结果和实验结果的对比相关系数大于99%,说明本文所建立的 率相关内聚力模型具有较高的准确性,能够准确描述加载率为5~200mm/min时推进剂/衬层界面的断裂性质.

英文摘要:

In order to build up a rate-dependent cohesive zone model (CZM) of the interface between hydroxyl-terminated polybutadiene(HTPB) propellant and insulation, experimental method and inverse analysis were adopted. Improved single lap joints (SLJ) specimens were used to conduct the HTPB propellant and insulation interface debonding experiment, then a numerical analysis was conducted with cohesive elements method, and with an inverse program developed based on Hook-Jeeves optimizing algorithm, the inverse analysis was conducted for the SLJ specimens to calibrate the interface parameters in different loading rates. Considering the significant rate-dependency shown in the parameters, a rate-dependent damage function was built and then the rate-dependent interfacial type Ⅱ CZM of HTPB propellant and insulation was built based on the bilinear CZM. The correlation coefficient between the predicted result and the experimental result is bigger than 99%, illustrating the rate-dependent CZM referred herein can accurately describe the fracture properties of propellant and insulation interface for the loading rate of 5mm/min to 200mm/min.

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