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波瓣数对波瓣S型混合二元喷管气动热力性能影响

Effect of lobe number on aerothermodynamic performance of lobed S-shaped two-dimensional nozzle

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中文关键词: 波瓣混合器 波瓣S型混合二元喷管 波瓣数 流向涡 热混合效率 总压恢复系数

英文关键词: lobed mixer lobed S-shaped two-dimensional nozzle lobe number stream-wise vortex thermal mixing efficiency total pressure recovery coefficient

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中文摘要:

依据某型涡扇发动机波瓣S型混合二元喷管,保持波瓣混合器长度、内扩张角、外扩张角以及宽高比不变,依次取波瓣混合器波瓣数为12,14,16,18,20,建立了一组具有不同波瓣数的波瓣S型混合二元喷管模型.采用经过验证的CFD方法,研究了波瓣数对波瓣S型混合二元喷管气动热力性能的影响规律.结果表明:在波瓣尾缘截面至第1个S弯截面区域,波瓣数对流体混合程度产生很大影响,并且热混合效率近乎随波瓣数增加而增加.在第1个S弯截面至波瓣S型混合二元喷管出口截面区域,波瓣数为16的波瓣S型混合二元喷管模型的总压恢复系数始终最低,其余模型的总压恢复系数以及热混合效率没有明显差别.在波瓣S型混合二元喷管出口截面上,波瓣数为16的波瓣S型混合二元喷管模型的热混合效率最高,达到0.850,然而其总压恢复系数相对于该截面上最高值下降了0.289%.此外,波瓣S型混合二元喷管的渐缩型流道能够提高流向涡强迫混合效果,但同时也加速流向涡的耗散速率.

英文摘要:

Based on a lobed S-shaped two-dimensional nozzle of a turbofan engine, the length, inner divergence angle, outer divergence angle and ratio of high to width of lobed mixer were kept unchanged only with the lobe number fixed as 12, 14, 16, 18, 20. A group of lobed S-shaped two-dimensional nozzle models with different lobe number were built. By the use of validated CFD simulation, the effect of lobe number on aerothermodynamic performance of lobed S-shaped two-dimensional nozzle was investigated. The results show that within the flow field between the lobe trail cross section and the first S bend, the degree of mixing is highly affected by the lobe number and the thermal mixing efficiency increases as a response to the increment of lobe number. Within the flow field between the first S bend and the exit of the lobed S-shaped two-dimensional nozzle, the lobed S-shaped two-dimensional nozzle model with 16 lobes always has the lowest value of total pressure recovery coefficient and neither thermal mixing efficiency nor total pressure recovery coefficient has distinct change between other models. At the exit of lobed S-shaped two-dimensional nozzle, the lobed S-shaped two-dimensional nozzle model with 16 lobes has the highest thermal mixing efficiency of 0.850, while total pressure recovery coefficient of the model has dropped by 0.289% when compared with the model of the biggest total pressure recovery coefficient. Besides, the gradual narrowing flow passage of the lobed S-shaped two-dimensional nozzle can contribute to better mixing and more rapid consumption of stream-wise vortex.

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