Adiabatic Film/Transpiration Cooling Effectiveness of an Additively Manufactured Structures

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Objective

- In this study, leading edge of blade section along with transpiration cooling and S-shaped NPR structured are printed by using IN718 powder in EONINT M270. Printed material is further tested in wind tunnel along with PSP for different blowing ratio.

Why Transpiration cooling

- High temperature at turbine section
- TS diagram for Brayton cycle

Why Additive Manufacturing

- Conventional manufacturing – casting process to manufacture simple cylindrical surface

Why NPR Structures

- NPR (Negative Poisson Ratio) or auxetic structures change shape under loaded conditions, as a result of which effective stress is reduced and life of the part increases. Additive manufacturing allow a pathway to making such parts.

AM transpiration

- Direct Metal Laser Sintering process (DMLS-EOSINT M270) for turbine blade manufacturing
- Printed leading edge section and printing parameter set (d=0.5 mm)
- NDE evaluation about concentricity (quality checking)

S-Shaped NPR structures

- Study of high performance auxetic geometries designed around a Negative Poisson Ratio (NPR) for combustion liners.
- Utilization of auxetic structures in combustion liners to mitigate for low component life.
- Higher Energy Absorption
- NPR Combustion Liners offer higher quality fracture resistance.
- Effective cooling configuration and acoustic damper

References