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Recent Studies in Turbine Blade Internal Cooling

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Gas turbines are used extensively for aircraft propulsion, land-based power generation, and industrial applications. The turbine inlet temperatures are far above the permissible metal temperatures. Therefore, there is a need to cool the blades for safe operation. Modern developments in turbine cooling technology play a critical role in increasing the thermal efficiency and power output of advanced gas turbine designs. Turbine blades and vanes are cooled internally and externally. This paper focuses on turbine blade internal cooling. Internal cooling is typically achieved by passing the coolant through several rib-enhanced serpentine passages inside the blades. Impinging jets and pin fins are also used for internal cooling. In the past 10 years there has been considerable progress in turbine blade internal cooling research and this paper is limited to reviewing a few selected publications to reflect recent developments in this area. In particular, this paper focuses on the effects of channel inlet geometry, sharp 180-deg turning, and channel cross-section aspect ratio on the coolant passages heat transfer at high rotation number conditions. Rotation effects on the blade leading-edge triangular-shaped channel and trailing-edge wedge-shaped channel with coolant ejection are included. Heat transfer correlations for a wide range of rotation numbers are provided. The computational flow and heat transfer results using the RANS method with various turbulence models are also mentioned for comparison.