INTEGRATION OF FILM COOLING IN A MICRO ROTATING DETONATION COMBUSTOR

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Abstract
Rotating Detonation Combustors (RDCs) have gained significant interest for their potential to enhance the efficiency of gas turbines through detonation-based Pressure Gain Combustion (PGC). RDCs offer higher power density and simpler designs compared to conventional deflagration-based combustion systems, positioning them as promising candidates for advanced propulsion technologies. Their self-sustaining combustion process, high-frequency compatibility with turbines, and mechanically simple geometry make them particularly suited for integration into Gas Turbine (GT) systems. However, the high thermal loads generated during detonation combustion present significant challenges, especially for compact configurations like micro-RDCs.
Micro-scale RDCs provide a valuable platform for studying detonation dynamics and optimizing combustor designs across a range of conditions. Their reduced size lowers manufacturing costs and enables exploration of different configurations and operating regimes. Moreover, understanding their operational boundaries is essential for expanding their use in smaller, specialized propulsion systems. Cooling remains a critical concern, as these combustors experience extreme thermal stresses that could impact long-term performance and stability.
This study presents a newly developed experimental facility designed to evaluate a micro-RDC geometry incorporating a film-cooling system. The facility focuses on investigating the effects of film cooling on wall temperatures and detonation wave behavior. Prior studies have shown that film cooling can reduce combustor wall temperature while maintaining detonation stability. These findings suggest that film cooling can enhance thermal management while preserving the core operational features of detonation-based combustion. The upcoming results will offer insights into applying film cooling in small-size detonation-based combustors and advancing cooling strategies for propulsion systems.