Performance tests of the slinger combustor for a micro turbo-jet engine

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A combustor full pressure rig test and altitude ignition test were carried out for radial-annular combustor of micro turbojet engine. A gasturbine combustor is developed mostly by performance test and modification based on the test results. Thus, the combustor rig test and high altitude ignition test are important procedure for developing a combustor. The ground condition performance test was carried out at the combustor test facility in KARI. High altitude ignition test was carried out at AETF (Altitude Engine Test Facility) in KARI, because the test requires low temperature and pressure condition than ground atmospheric condition.

The tested combustor has radial annular shape with slinger type rotating fuel nozzle. Shape of the combustor is shown in figure 1. The test rig for this combustor, unlike general combustor test rig, has built-in high speed motor to rotate the nozzle during test.

The test was performed at the condition identical to the design point condition. 11.2% total pressure loss and combustion efficiency over 99% were measured at design point of combustor under sea level standard condition. Combustion efficiency was measured by exhaust gas analysis. For ignition envelope, air excess ratio of 2–6 was achieved on engine starting regime. Air excess ratio limit for ignition is extended for higher nozzle rotating speed due to the better spray atomization. 30,000 ft high altitude ignition test was also performed. High altitude ignition was also successful, though the ignitible air excess ratio limit was decreased for high altitude condition. O2 injection to enhance high altitude ignition performance was tried and it worked out efficiently.

Combustor exit gas temperature profile was measured by K-type thermocouple installed on rotating temperature rakes. The liner temperature was also measured by small diameter SUS sheathed K-type thermocouples attached on the liner outer surface. These temperatures are important characteristics for the engine endurance life. The measured temperature and temperature profile were within system requirement of the combustor.

Consequently, the test result was satisfactory and the developed radial-annular combustor is appropriate for micro turbojet engine.

Fig. 1 Test combustor modeling  
Fig. 2 High altitude ignition test result