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A monopropellant micro-propulsion device in low temperature co-fired ceramics[1] DONALD PLUMLEE, AMY MOLL, AARON COULTER, Boise State University, JUDI STECIAK, RALPH BUDWIG, University of Idaho — A planar nozzle constructed in Low Temperature Co-Fired Ceramics (LTCC) has been developed for use in micro-propulsion applications. Three converging-diverging supersonic nozzle configurations were developed and tested using the LTCC materials system. A typical nozzle had a throat .17 mm wide by .22 mm deep, an exit Mach number of 2.4, and a thrust of 0.25 N. An isentropic model was generated to determine nozzle throat and exit size and nozzle curvature was defined using a method of characteristics approach. Each nozzle was tested using a cold gas test stand at several pressures. The experimental thrust measurement was compared to several models. The isentropic model predicted the actual thrust to within 25%, while 3D CFD with a Spalart-Allmaras (SA) turbulence model predicted the thrust to within 5.9%. A schlieren visualization system was implemented to further validate the CFD results. The density gradient of the nozzle plume using the SA turbulence model matched the schlieren image of the shock locations in the nozzle exit plume. Additional testing was performed with hydrogen peroxide as a monopropellant being delivered to the nozzle through a LTCC, silver embedded catalyst chamber.

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