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Preliminary experimental study on solid-fuel rocket scramjet combustor

Key words:
Solid fuel, Rocket scramjet, Dual combustor, Direct-connect experiment

Category

	Types of propellant	Engine	Example
Ramjet	liquid	Liquid-fueled ramjet	Asura
	solid	Solid-fueled ramjet	
		Integral rocket ramjet / ducted rocket	Meteor
Scramjet	gas	Gasous-fueled scramjet	X43A
	liquid	Dual mode scramjet	X51
		Dual combustor scramjet	Hyfly
	solid	Solid-fueled scramjet	
		Rocket scramjet	

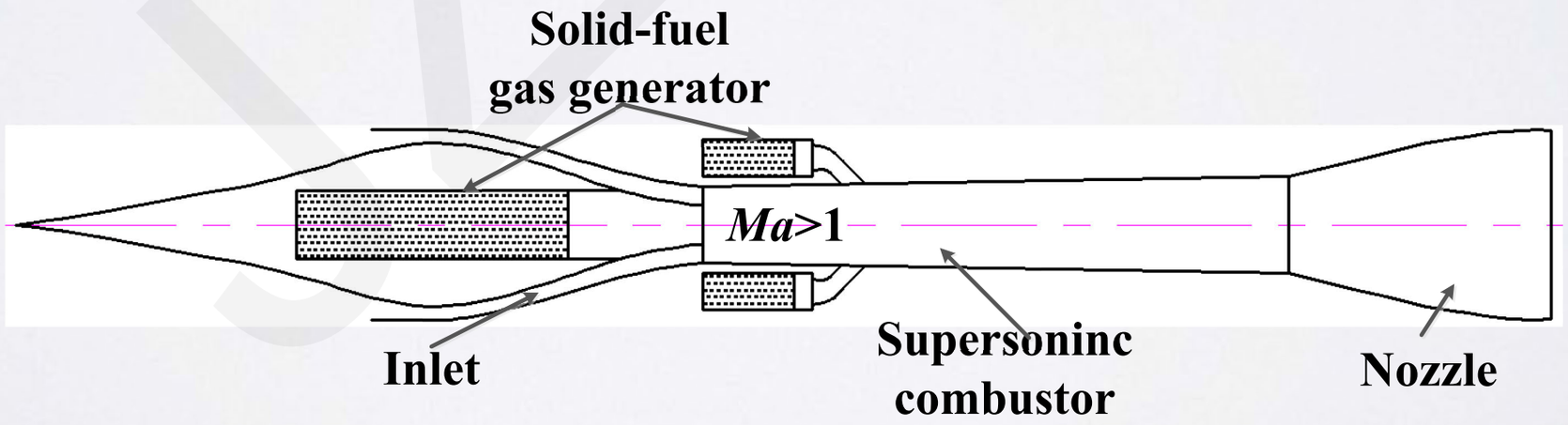

Fig. 1 Schematic of potential solid-fuel rocket scramjet

Experimental setup

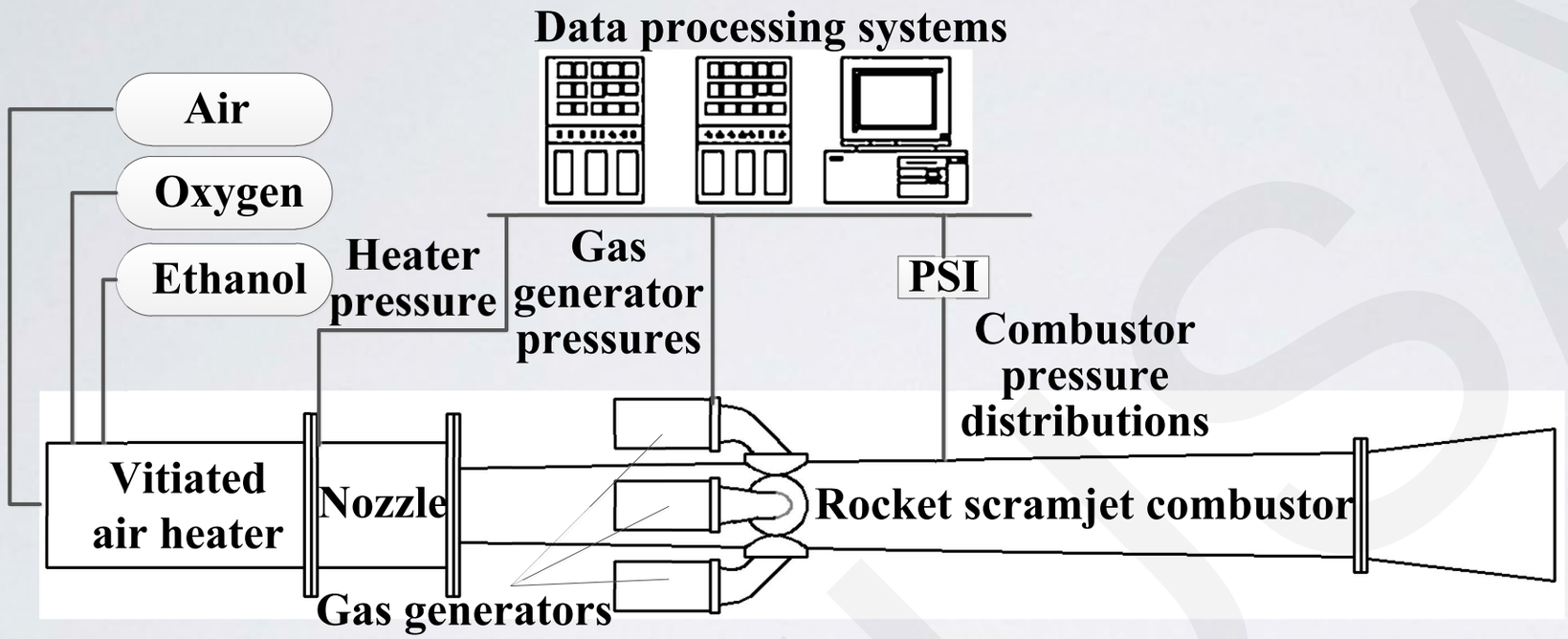

Fig. 2 Schematic of test facility

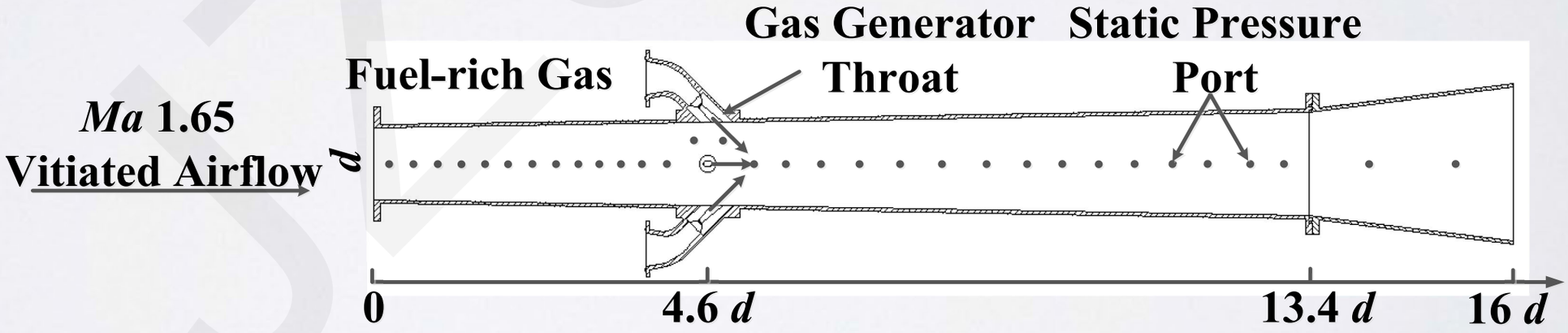

Fig. 3 Schematic of tested combustor

Results

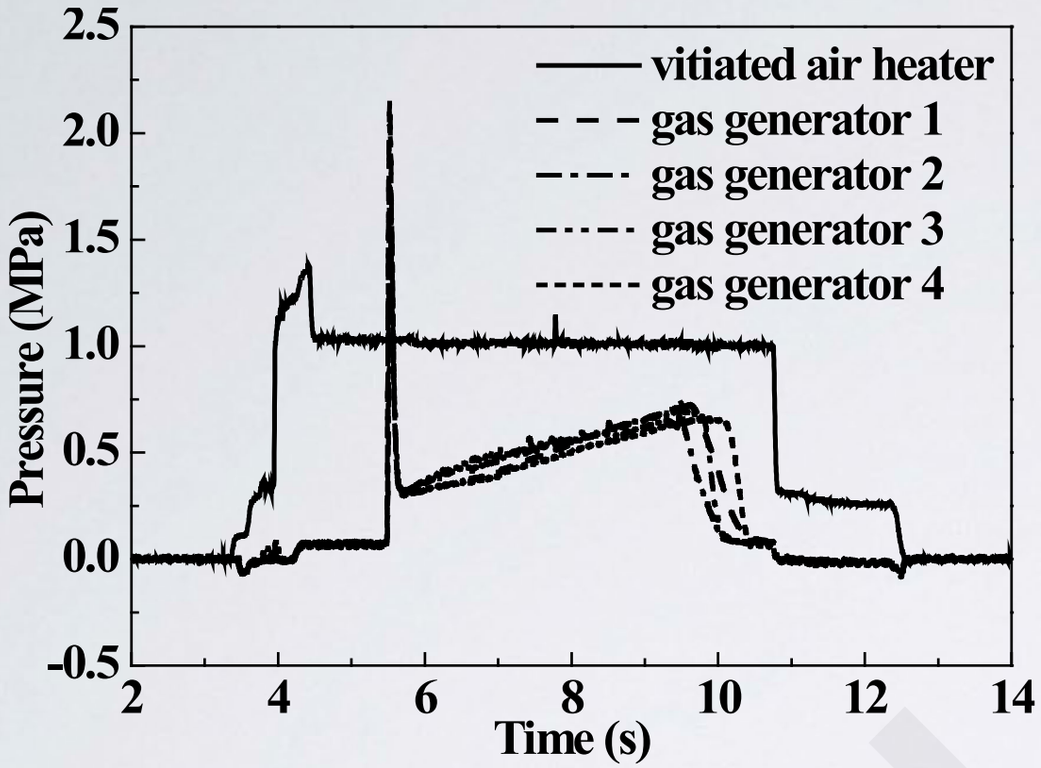

Fig. 4 Pressure in gas generators

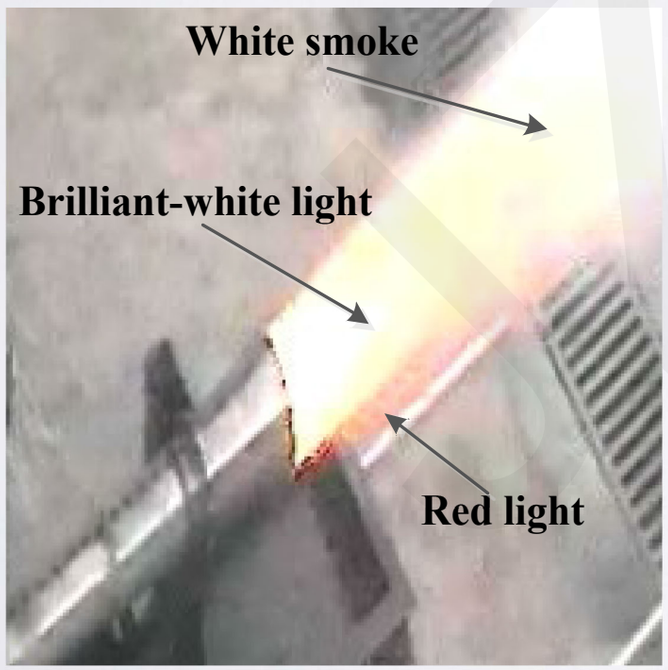

Fig. 6 Flame at the exit of nozzle

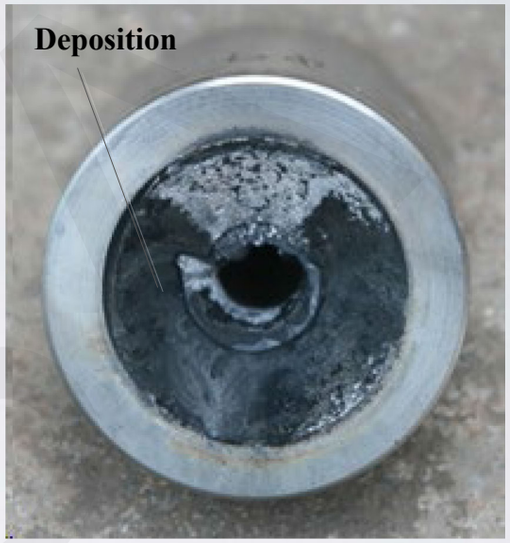

Fig. 5 Deposition on the surface of gas generator throat

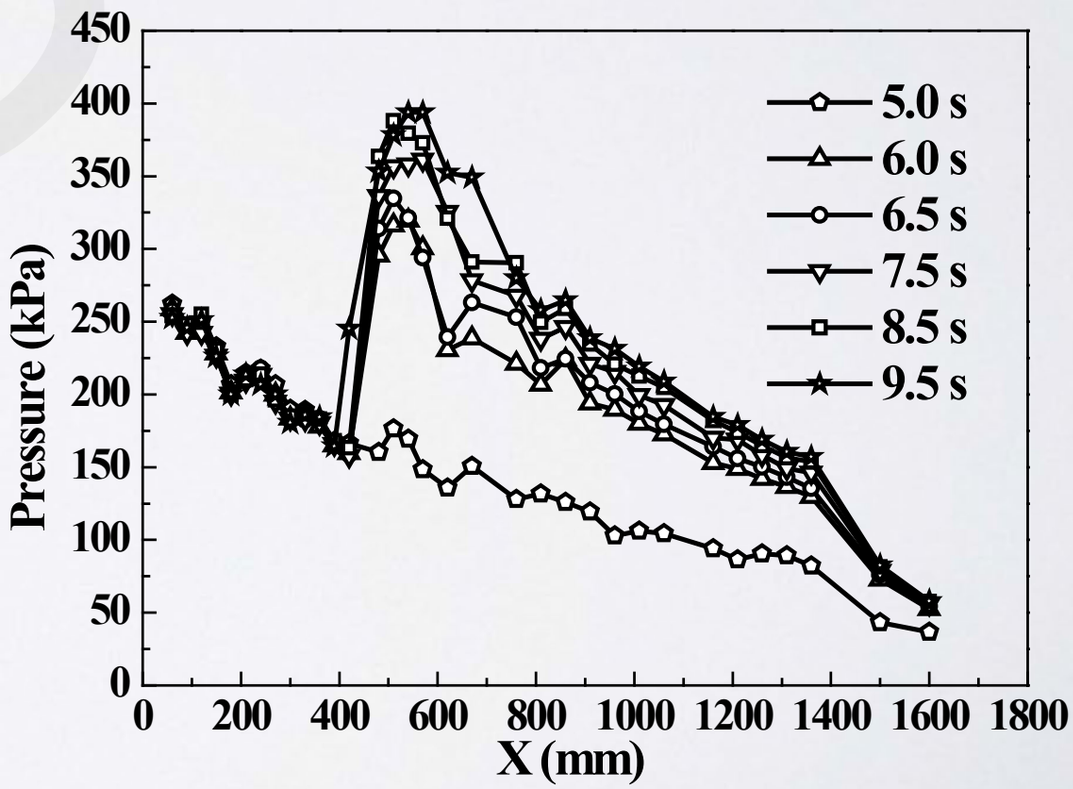

Fig. 7 Pressure distribution along the combustor

Conclusions

An experimental study of the solid-fuel rocket scramjet combustor is conducted. The results are summarized as follows:

- Fuel-rich gas from gas generation can burn with the air in the supersonic combustor, and the configuration of the solid-fuel scramjet is feasible.
- A preliminary evaluation of the performance of the solid-fuel rocket scramjet is carried out. The total pressure recovery coefficient in the supersonic combustor is about 0.6, and the combustion efficiency of the propellant is about 90%.
- Some initial-combustion products froze on the surface of the throat of gas generator. It decreases the diameter of the throat and results in the pressure rise in the gas generator. It also induces the increase of mass flow rate of fuel-rich gas.
- The total pressure loss is mainly located in the region in the vicinity of the fuel-rich gas injection. The loss is mainly induced by the shock waves resulting from fuel injection and secondary combustion of fuel-rich gas with air.