Experimental investigation of the continuously rotating detonation in annular chamber for liquid fuels-air mixtures

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Abstract

Development of liquid fuel-air supply system for the application of continuously rotation detonation in annular chamber which could be used in an air-breathing engine is presented. As a first step an experimental research of combustion of liquid fuel in a simple diffusion burner were conducted. This studies were focused on evaluation of conditions under which length of diffusion flame can be minimalized. Such system was based on the injection of preheated fuel mixed with air at the condition close to and above rich flammability limit. In such case fuel could be completely evaporated but ignition of the mixture will not happen. Then such system was applied to annular detonation chamber. Experiments were conducted for two different liquid fuels: extraction gasoline and Jet-A. Research was conducted for variable equivalence ratio and conditions under which continuously rotating detonation in annular chamber was achieved and evaluated.

On the base of conducted experiments it is clearly seen that if the fuel-air mixture is properly prepared, stable continuously rotating detonation in annular chamber can be achieved. Evaporation of liquid fuel before injection to the detonation chamber is most important to provide appropriate conditions to support stable detonation in the chamber. Obviously, chamber/channel dimensions, initial pressure and rate of supply mixtures play also crucial role in supporting stable continuously rotating detonation.

This method of liquid fuel preparation and injection into annular detonation chamber opens a way of application of liquid fuels to air-breathing engines which utilize continuously rotating detonation and thus prepares the way for practical application of detonative combustion to turbine engines and other jet propulsion systems.