

Effects of projection length and diameter of ion-probe on flame detecting characteristics in 2-stroke gasoline engine

Multiple ion-probes method is one of the beneficial method to obtain the detailed information of explosive combustion such as knocking in spark ignition engine. Multiple ion-probes method uses plural ion-probes installed along the chamber wall. Each ion-probe detects the arrival of flame. Not only the movement of the flame, but also the shape of the flame front at a specific moment can be regenerated from captured data set by multiple ion-probes. It has been clarified by the previous studies using combustion test tube that multiple ion-probes method has great potential for capturing the detailed behavior of propagating flames from heavily tabulated low-speed flame to supersonic detonation.

Our group is now trying to expand the measurement ability on multiple ion-probe method from highly-controlled combustion in combustion test tube to highly-unstable combustion such in spark ignition engines. In the previous studies we conducted, multiple ion-probes method was able to capture the propagating flame in 2-stroke gasoline engine in limited conditions. However, flame signal in 2-stroke gasoline engine is considerably weak compare to well controlled combustion in test tube. Moreover, the flame signal tends to be lost in the noise of spark. Therefore, stronger flame signal is required for reliable flame detection.

In the present study, effects of the shape of ion-probe on flame detection characteristics in 2-stroke gasoline engine was investigated. Tested parameters of the shape in ion-probe were projection length and diameter of ion-probe wire. Projection length was changed as 0, 0.5, 1.0, 1.5mm. Test results say that projection length has positive effects for flame detection. Longer projection length has higher sensitivity for flame detection. However, longer projection should be avoided because long projected ion-probe disturbs the flame itself and it becomes negligible. Diameter of ion-probe wire was changed as 0.3, 0.5, 0.7, 1.0mm. Experimental results indicate that the size of diameter has negative effects on mean strength of detected flame signal. Although the detailed reason is still investigated, one possible reason is as follows. Combustion in piston engine varies widely in general. Ion-probe with larger diameter detects the weaker flame, and this makes mean value of detected flame signal small.