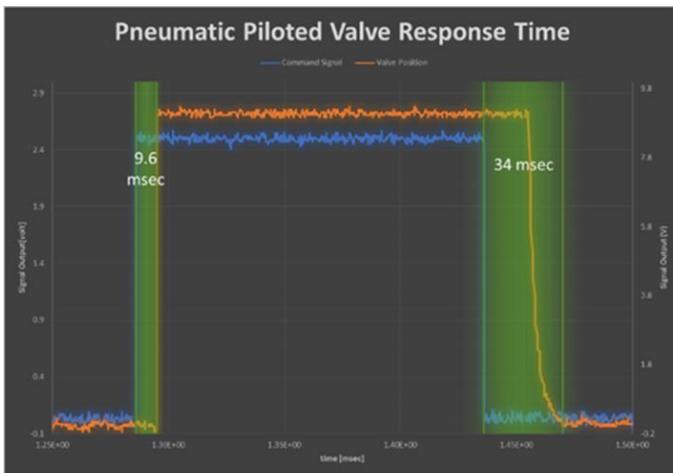
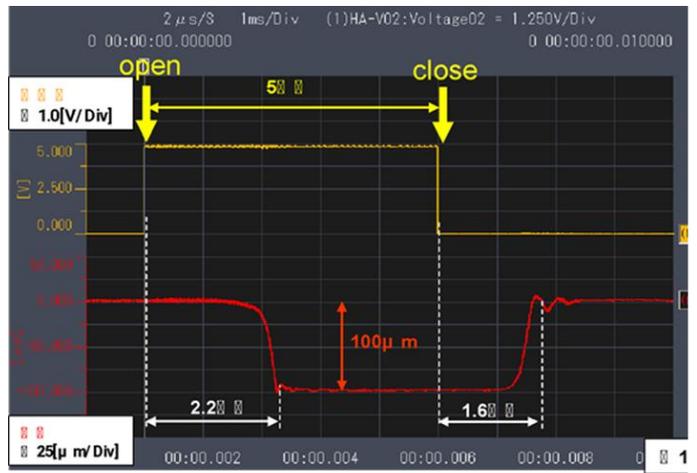


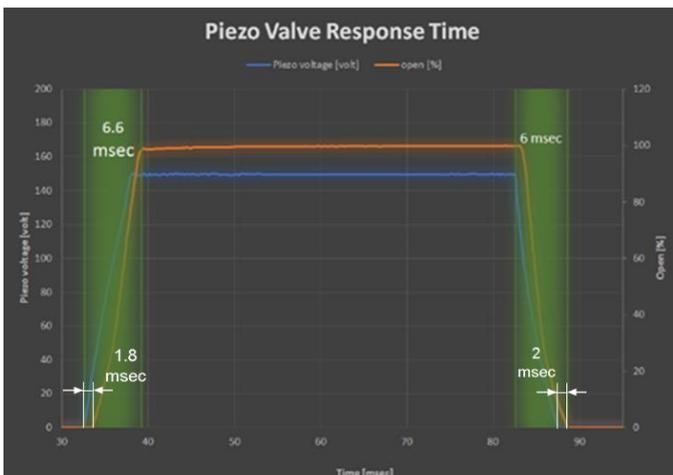
Fig.1 Conceptual diagram of this study.



Pneumatic valve



Solenoid valve



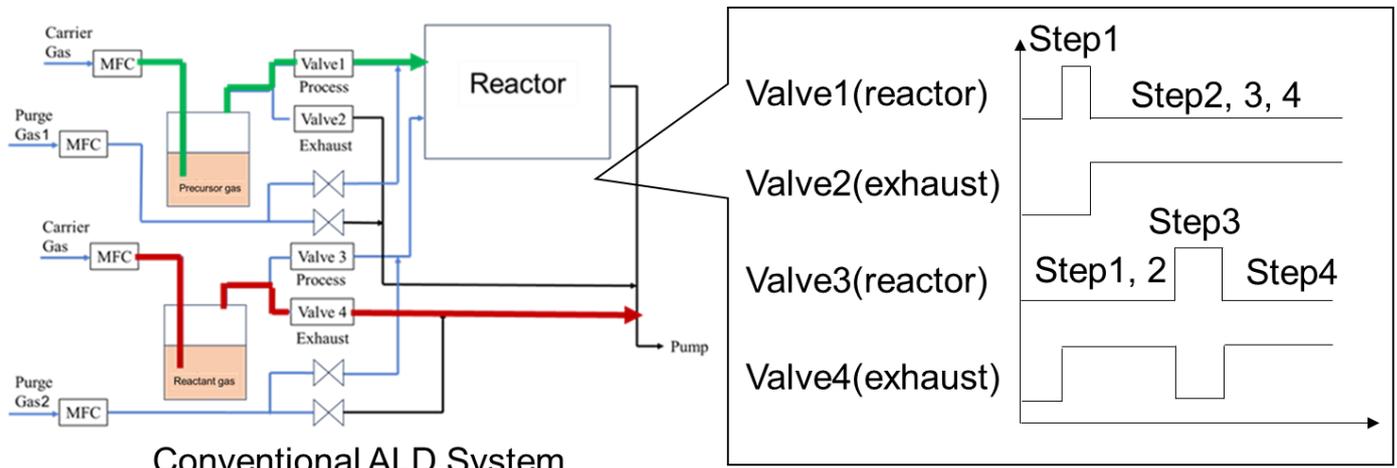
Piezo valve

Type of Valves	Response time [ms]
Pneumatic valve	9.6 ~ 34
Solenoid valve	2.2
Piezo valve	~2

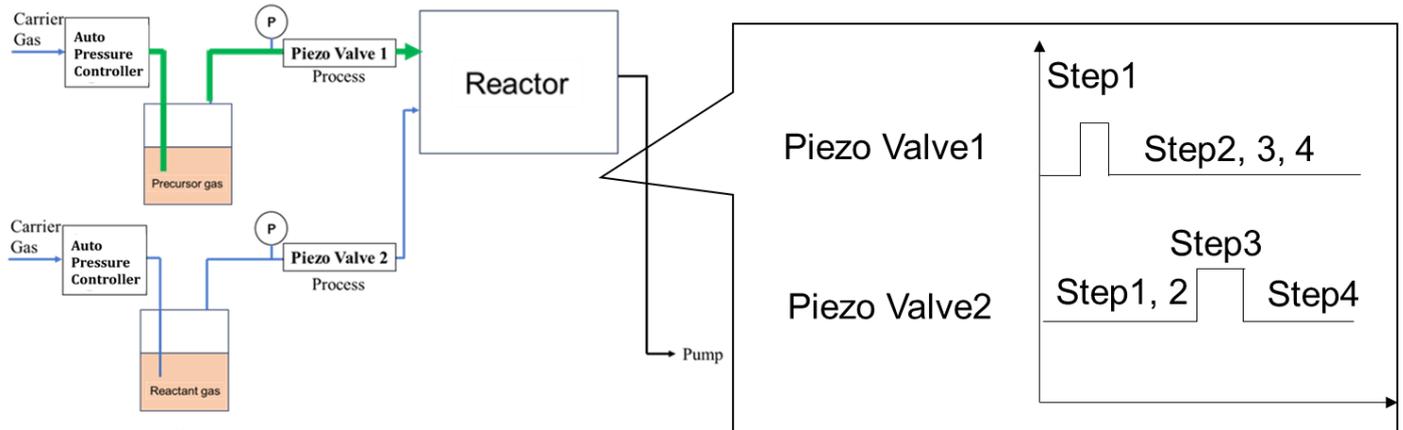


Piezo valves have the fastest response.

Fig.2 Typical response time of valves to input signals

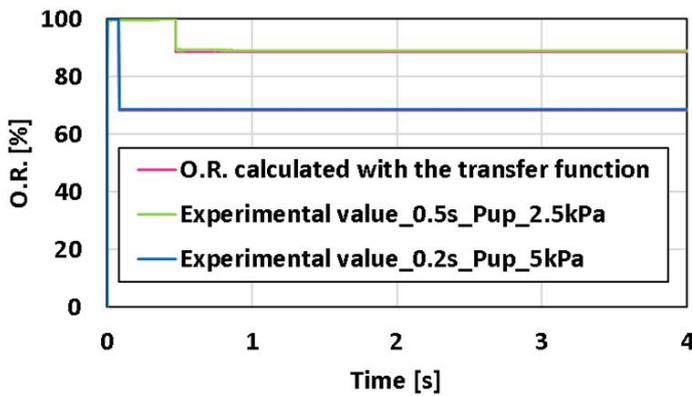


Conventional ALD System



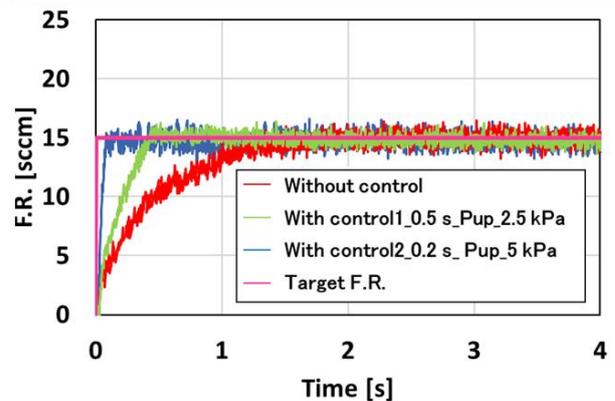
“NEW” On-Demand delivery System

Fig.3 Conventional ALD System and On-Demand delivery System.



Opening Ratio(O.R.) vs. time

O.R. matched the one calculated from the transfer function, with an error rate of 0.3%.



F.R. vs. time

Settling time of F.R. Without control : 2 [s]
 Settling time of F.R. with control 1 : 0.5 [s]
 Settling time of F.R. with control 2 : 0.2 [s]

Target value was reached almost instantly.

Fig.4 Time variation of flow rate and aperture ratio with and without control.