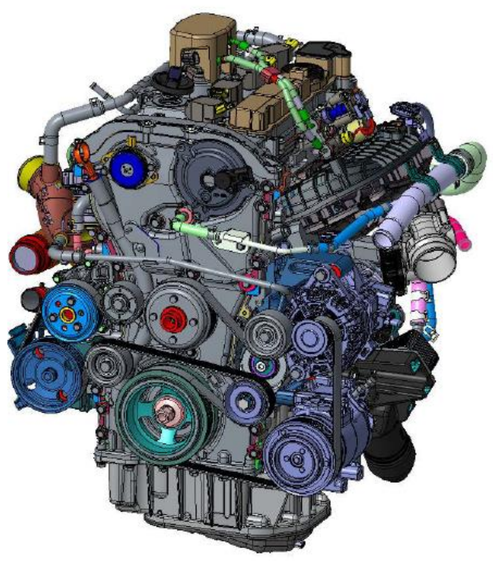
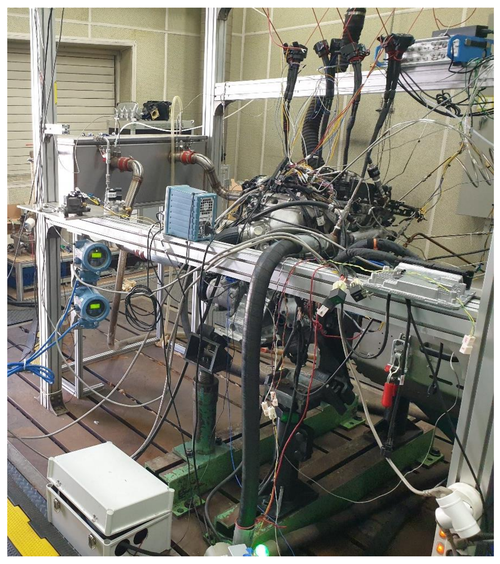
Study on the Effects of Operating Conditions on Nanoparticle Emissions in Direct Injection Ammonia Engines

Cheolwoong Park (cwpark@kimm.re.kr), Korea Institute of Machinery and Materials

Research target

Item	Specifications
Ignition type	Spark Ignition
Fuel injection type	Direct Injection (150bar)
Turbocharger type	Waste gate
Cylinder No.	4
Bore × Stroke	88.5 mm × 101.5 mm
Displacement volume	2.5 L
Compression ratio	10.5 : 1
Max. Power	138 PS at 3,800 rpm
Max. Torque	300 Nm at 1,250~3,800 rpm

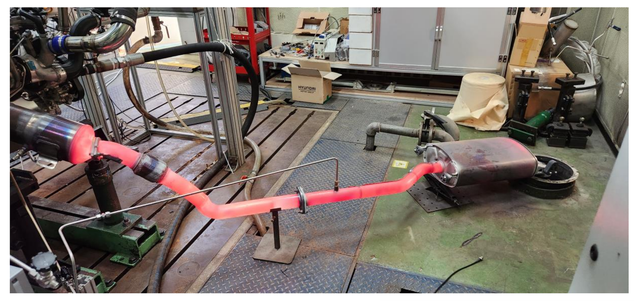


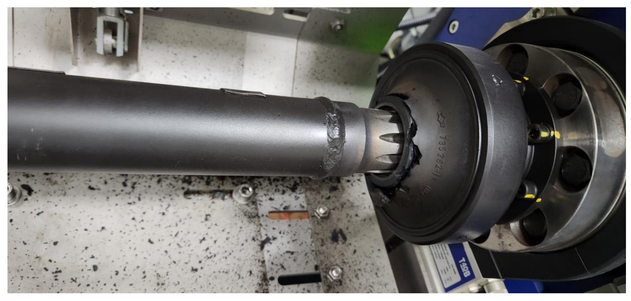


- Feasibility assessment of performance / fuel efficiency / exhaust gas through evaluation of ammonia engines and deriving improvement items
- Confirmation of the minimum required amount of hydrogen (energy ratio) to ensure stable combustion when ammonia + hydrogen is mixed

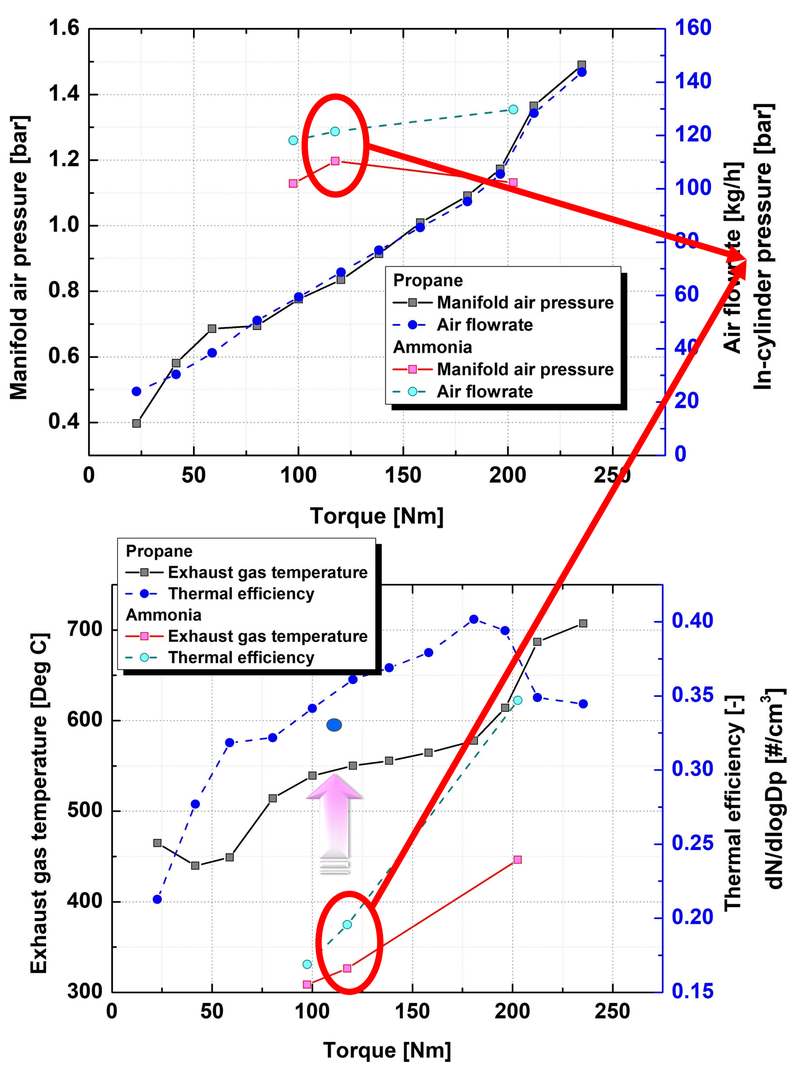
Research contents

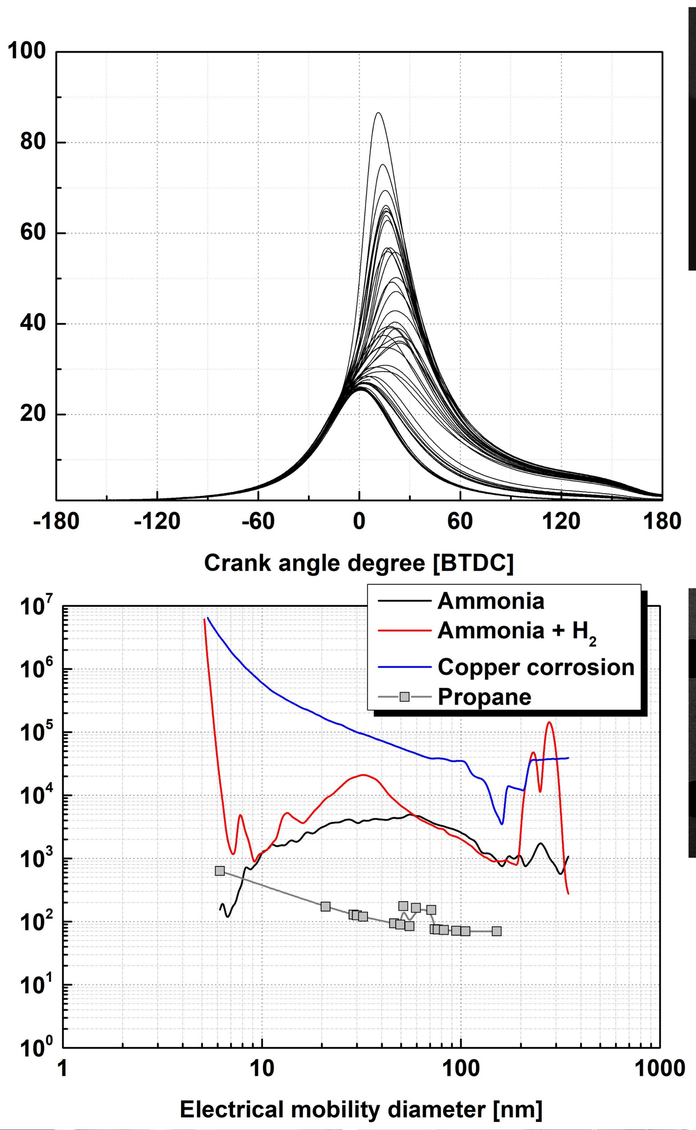
- Ammonia engine configuration and operation area confirmation
- Evaluation of deployment performance, fuel economy and emissions (NOx, CO2, CO, HC)
- Check combustion characteristics by control factors (air-fuel ratio, ignition type, fuel injection control method, etc.)
- Confirmation of changes in combustion characteristics according to the amount of hydrogen added

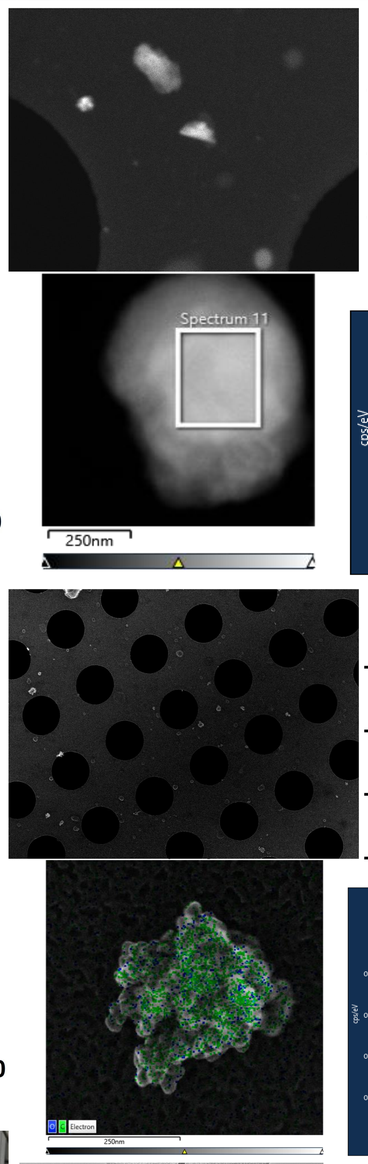


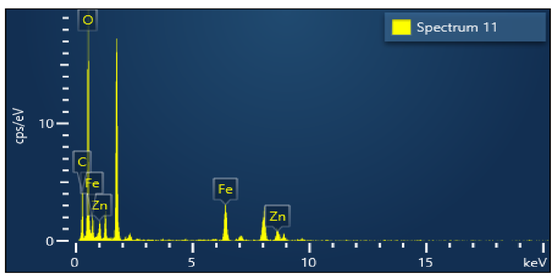


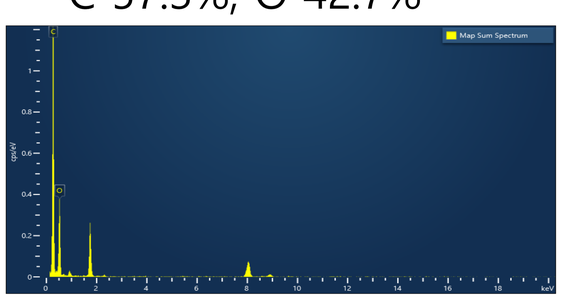
Results

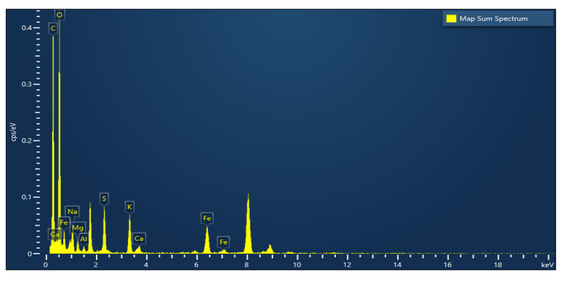


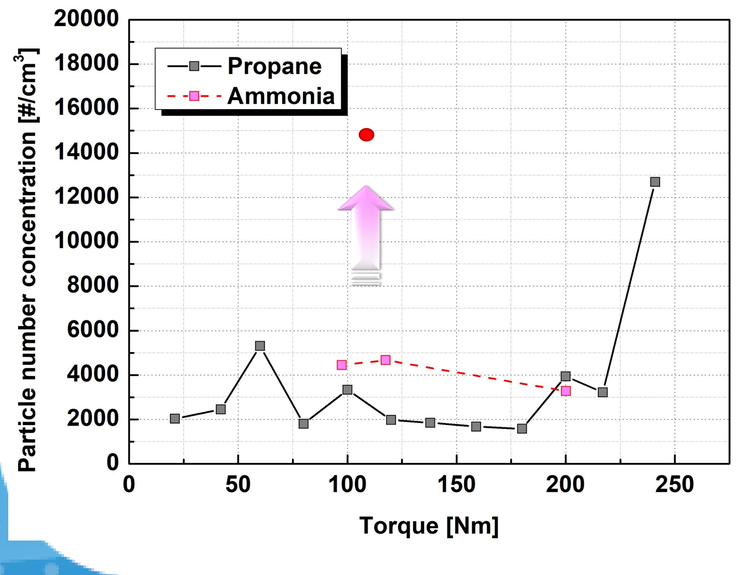


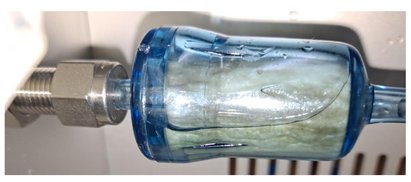












Exhaust	NH_3 [ppm]	NO_x [ppm]
Ammonia	17,259	2,091
Ammonia+H_2	11,275	3,221

Ammonia

- Traces of evaporation
- Evaporation by EDS
- C 32.6%, O 41.9%
  Fe 18.1%, Zn 7.4 %

Ammonia + H_2

- Traces of evaporation
- Evaporation by EDS
- More Carbon
- C 57.3%, O 42.7%

Copper corrosion

- No Traces of evaporation
- Larger Iron particles
- No corroded particles

KIMM 한국기계연구원 KOREA INSTITUTE OF MACHINERY & MATERIALS