Development of the Automotive Version of an Atomic Hydrogen Generator for Reducing Nitrogen Oxides in Internal Combustion Engine Exhaust Gases

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Keywords: Internal Combustion Engine, dissociation of hydrogen, plasmatro

We propose a method for neutralizing nitrogen oxides in exhaust gases using atomic hydrogen, according to which the radical-chain reactions for the reduction of nitrogen oxides proceed actively in the exhaust pipe of the internal combustion engine with the participation of hydrogen atoms, without a heterogeneous catalyst containing precious metals. For the dissociation of hydrogen molecules into atoms directly in the exhaust pipe of the internal combustion engine, a generator of barrier electric-arc discharge (plasmatron) is proposed. The Laboratory tests confirmed the viability of this method for NOx neutralization and the promise of continuing research in this direction.

The article discusses the issues of development of a compact, vehicle-adapted version of an atomic hydrogen generator for reducing nitrogen oxides in internal combustion engine exhaust emissions. In particular, the design of a barrier discharge generator (plasmatron) for producing atomic hydrogen was developed, its dimensions were determined, and materials for the housing and electrode windings were selected.

The type and material were selected and an indicator for determining a degree of dissociation of the molecular hydrogen into atoms within the barrier discharge generator was manufactured. An holder design for attaching the indicator to the outlet cross-section of the plasmatron was produced, and the temperature of the hydrogen flow exiting the electric arc discharge zone was measured in the holder. To reduce the recombination period of hydrogen atoms, an ejector was developed and manufactured for reducing excess gas pressure in the zone, where the atomic hydrogen generator is mounted on the engine outlet pipeline.

The degree of dissociation of hydrogen molecules, and consequently the degree of NOx neutralization, was determined depending on the voltage applied to the plasmatron electrodes. In particular, by increasing the voltage from 4.5 to 7.3 kV, the reduction in NOx concentration reached 31%.

Acknowledgements. This work was supported by Shota Rustaveli National Science Foundation of Georgia (Grant AR-25-720).

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