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Ethylene treatment using nanosecond pulsed discharge

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Ethylene is a gas released from fruits and vegetables and has the effect of promoting their growth. Today, fruits and vegetables of various types are transported together by container ship. However, ethylene release amount and product sensitivity toward ethylene depend on product type; thus, if product with high ethylene release such as apples are mixed with that with high ethylene sensitivity such as persimmons, the latter will ripen excessively. Non-thermal plasmas (NTP) such as dielectric barrier discharges (DBD) and corona discharges have been investigated as a way to decompose ethylene. The nanosecond (ns) pulsed discharge is one of NTP and is known that generate O3, treat exhaust gases and decompose VOCs with higher energy efficiency. However, many issues still remain prior to industrial implementation, including increasing energy efficiency for the removal of residual HCOOH, CO, and O3 as byproducts; there are also decomposition limitations in areas of low ethylene concentration. Overcoming these limitations is the purpose of this work.
The output voltage of the ns pulse generator was 30 kV −50 kV in amplitude, 10 pulse/s −100 pulse/s in repetition rate, and 5 ns in pulse width. The 100 ppm ethylene which was diluted with dried air was employed as simulated gas of the transportation container. The gas mixture was fed into the coaxial cylinder type reactor for the evaluation of the decomposition efficiency. Ethylene concentration decreased to less than 0.1 ppm after ns pulsed discharge treatment at 30 J/L in input energy density. O3, CO, N2O, HCOOH, HNO3 were generated as byproducts; byproduct concentrations were measured.

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