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Pulsed plasmas for two environmental applications: Power-to-Methane and pollution control

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Nanosecond pulsed plasmas at ambient conditions can be tailored to energize chemical processes that help to cure environmental problems. We report here two application areas: industrial emission control and fuel synthesis.
A short review will be presented of the development and industrial performance of a pilot size installation for on-site emission abatement [1]. The pilot installation has been built around a pulsed power driven streamer-corona reactor. The power source is a high-efficiency spark-gap based device which can operate autonomously for long periods of time. It is a self-controlled system operating at up to 10 kW average power, and at pulse parameters of 100 MW peak power, 1 kHz pulse repetition rate and 100 ns pulse width.
Next, we present the development of a plasma-catalytic reactor for methane synthesis. The feedstock is CO2, water vapor and renewable power. This research originates from first ideas and results that we presented in a recent paper [2]. The paper showed that 400 ppm of Methane was synthesized by a pulsed corona discharge around a Nicrothal 80 wire in CO2 above a water surface. A new device is in development to optimize this process. It combines a dedicated catalyst, a corona reactor, humid CO2 gas and nanosecond pulsed power. First results will be presented. Technology developments in this direction are needed to be able to convert the surplus renewable power of the near future.

[1] F.J.C.M. Beckers, Pulsed Power Driven Industrial Processing, Thesis Eindhoven University of Technology, ISBN 978-90-386-3982-6.

[2] W.F.L.M. Hoeben, E.J.M. van Heesch, F.J.C.M. Beckers, W. Boekhoven, and A.J.M. Pemen, Plasma-Driven Water Assisted CO2 Methanation , IEEE Transactions On Plasma Science, Vol. 43, No. 6, June 2015

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