EPFL STI IMT-NE PV-LAB

Seminar

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MT 2 11.00

Rue A.-L. Breguet 2, CH-2000 Neuchâtel

Breakdown between structured parallel plates

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ABSTRACT

This talk presents an experimental investigation into RF breakdown for parallel plate electrodes with holes or protruding features, approximating the situation in real reactors, and providing a benchmark for fluid simulations using a drift-diffusion model with a finite-element solver.

In the design of PECVD reactors there are instances where the working gas will have to flow between parts of the RF electrode and grounded surfaces, or where it is not possible to isolate RF parts from grounded parts via the use of a dielectric. The solution to this problem is dark space shielding: small gaps in the range from one to a few millimetres, nominally too small for plasma to ignite. To properly design such gaps, it is important to understand the mechanisms which result in breakdown, especially in geometries more complex than the much-studied parallel-plate breakdown.

In this work the effect of holes or protrusions on the breakdown curve for low pressure breakdown was studied. This is not the same as vacuum breakdown which depends mainly on field emission.

Experiments and simulations show that for small gap breakdown in pressures of the millibar range, sharp corners play a negligible role in RF breakdown. Rather, it is the distance between the electrodes that will determine the RF breakdown voltage. This conclusion is supported by an extension of the analytical work done by Kihara [Rev. Mod. Phys., 24 (1952)] and Lisovskiy et al. [Phys. Plasmas, 12 (2005)], and a fluid simulation using a drift-diffusion model with a finite-element solver, which showed reasonably good agreement with experimental data.