Plasma, the fourth state of matter, makes up 99% of the visible universe. On Earth the diverse industries associated with plasma technology have been estimated to account for about 20% of the GNP. Present applications are found in practically every branch of modern industry, and range from fine structure etching and deposition in integrated circuit production to high power plasma torches. New developments in applications include atmospheric-pressure plasma processing, plasma addressing environmental problems, plasma medicine, and plasma nano-technology.

**Goals**

After the completed course you should be able to

- describe the plasma physical processes, and characterizing parameters, that are listed in the course content.

- explain the functioning, with focus on the dominating plasma physical processes, of the six discharge types that are listed in the course content.

- describe the technical applications of plasma processing that are listed in the course content, and explain how the discharge types’ characteristic parameters are related to the desired use of the devices.

- For the highest grade the student shall be able to apply the knowledge also to analyze and characterize other discharge types than those treated in the course.
Content

Instead of treating the whole, very wide field, of industrial plasma discharge types, the course focuses on six discharge types that have been selected so that they together exemplify most of the knowledge basis in applied plasma physics. For each discharge type the focus is on the plasma processes that determine its characteristics, and one or two examples of industrial applications are treated.

- Plasma physical processes: electron influx from surfaces by ion impact, thermal emission, field emission, cathode spots and corona emission. The balance of electron energy, both in ac and dc discharges. Plasma gain by ionization, and plasma loss by diffusion, recombination, and current losses. The self-bias process. Electron avalanches and streamers.

- Characterizing parameters: collisionality, degree of ionization, degree of magnetization (for ions and for electrons). Scale lengths: gyro radii, mean free paths for elastic collisions and for ionization, and sheath thicknesses. The Hall, Pedersen, and parallel conductivities.

- Discharge types: DC glow discharges, arc discharges, barrier discharges, corona discharges, sputtering magnetrons, and RF discharges.


Prerequisites

Basic electromagnetic field theory. EF2200 Plasma Physics.

Literature

M. Lieberman and A. Lichtenberg, *Principals of plasma discharges and materials processing*.

Selected journal articles and reviews.

Examination

TEN1 – Written Examination, 6.0 credits, grade scale: A, B, C, D, E, FX, F

Offered by

EES/Space and Plasma Physics

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