Introduction to High Power Impulse Magnetron Sputtering (HiPIMS)

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Course objectives

- Understand the fundamental processes in magnetron sputtering
- Gain a comprehensive description of the HiPIMS process from the fundamental discharge physics to applications
- Show how the HiPIMS process parameters can be adjusted to control film growth and thereby tune film properties, including hardness, homogeneity, and residual stress

Course description

I will give an introductory seminar on thin film deposition using high power impulse magnetron sputtering (HiPIMS), and how this sputtering technique differs from conventional magnetron processes. The seminar includes a brief introduction to the fundamentals of thin film growth using magnetron sputtering with emphasis on the role and characteristics of the plasma. Experimental results and simulations, based on industrially relevant material systems, will be used to illustrate mechanisms controlling nucleation kinetics, column formation, and microstructure evolution.

Furthermore, ionization of sputtered atoms will be discussed in detail for various target materials, since it enables effective surface modification via ion etching and self-ion assistance during film growth, as well as being a key feature in HiPIMS. In addition, the role of self-sputtering, secondary electron emission, and the importance of controlling the process gas dynamics (both inert as well as reactive gases) will be examined in detail with the aim to generate stable HiPIMS processes.

We will also look at how to characterize the HiPIMS discharge to establish general trends on how to optimize any given HiPIMS process. Such process optimization will also allow us to identify what external parameters to adjust for controlling film growth and thereby tune film properties, including hardness, homogeneity, and residual stress.

Who should attend?

This course is mainly intended for students, engineers, and scientists interested in plasma-based thin film deposition and its applications.

Course material

Lecture notes based on the book *High Power Impulse Magnetron Sputtering* (Elsevier, 2020) will be provided.