[Physics for Future Innovation Seminar Series]

Engineering Physics for Semiconductor Equipment Innovation

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Abstract Semiconductor innovation primarily relies on process innovation using the cutting-edge equipment. The manufacturing of semiconductors involves eight cirtical processes: etch, photolithography, chemical vapor deposition (CVD), clean, metal, chemical mechanical planarization (CMP), ion implentation, and diffusion. These processes are closely monitored using various different metrology and inspection equipment.

A key feature of these processes is that they are surface reactions conducted using chemicals, with plasma playing a critical role in their efficient execution. Advancing process equipment technology necessitates a profound understanding of plasma physics, alongside the development of hardware, software, and simulatin technologies for its ignition, control, and prediction. Moreover, metrology techniques require an exceptionally high level of resolution and sensitivity to detect deviations as small as 0.05nm, necessitating the use of light and electron beams and intricate optical methods.

This presentation will cover the essential and cutting-edge technologies understanding the physics of process equipment, highlighting the need for ongoing development. It will also explore the fundamental technologies required, such as plasma science, optics, simulation, artifical intelligence, and robotics. Additionally, the presentation aims to discuss the area where physics majors can contribute with interest from an engineering physics perspective.

Biography Jang Gyoo Yang is an Executive Vice President and Head of Mechatronics Research at Samsung Electronics since 2017. He joined the company in 2012 as a Vice President and served as Head of Fab Equipment Team. He is in charge of developing Samsung's next generation innovative equipment technologies with suppliers, and deploying them timely to keep the company's leading position in the industry.

Prior to joining Samsung, he held various technical position, Distinguished Member of Technical Staff, and leadership positions as senior director of engineering at Applied Materials, Intevac and Novellus from 2000 to 2012. His major contribution throughout his works was to explore the new idea including development and productization in Etch, CVD, and Dry Cleaning equipment with his expertise in RF and plasma technologies.

He started his career in fusion science and engineering. From 1994 to 2000, he was in charge of developing a high power RF/microwave heating system and operating the large-scale Magnetic Mirror Machine for the national plasma fusion facility as a team leader and a senior researcher at the Korea Basic Science Institute.

He obtained his Ph.D., M.S. Degrees in plasma physics from the Korea Advanced Institute of Science and Technology (KAIST), Daejeon, Korea.