**Hybrid surface manufacturing technologies using energy beams**

Past few decades were the era of precision manufacturing as machine parts have become smaller and more precise. Although the size of parts could be reduced by investigating precise manufacturing processes, surface quality including topography, texture, mechanical and chemical stabilities should be further modified as performance-to-size ratio become extremely high; required performance was continuously increased despite of the smaller size of mechanical parts.

The electron beam irradiation processes are generally used for analysis methods such as scanning electron microscope (SEM), transmission electron microscope (TEM), and electron backscattering diffraction (EBSD). Those applications are based on microscopic energy transfer, backscattering, and transmission of accelerated electrons. Although those electron beam-based irradiation techniques were possible to transfer energy to substrates, it was not enough to induce some changes including melting, phase transformation, and modification.

About a decade ago, large pulsed electron beam (LPEB) was introduced as the surface polishing method following the development of high current pulsed electron beam irradiation technique. Furthermore, based on the understandings on energy transfer mechanisms of high energy electron beams, it could be adopted for various surface modification and surface manufacturing. In this seminar, temperature predictive modeling for high energy electron beam irradiation will be introduced for the fundamental understandings of LPEB-based surface melting and re-solidification mechanisms. Moreover, surface modification factors will be summarized on different types of engineering materials. Finally, various multiscale applications of LPEB-based manufacturing processes will be introduced. Lastly, the diamond-like carbon (DLC) coatings using carbon plasma beams will be introduced as the application of another energy beam for surface manufacturing technologies.