Challenges and breakthroughs in plasma processing for advanced electronic devices

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The tremendous popularity of telecommunication and optoelectronic devices like wireless cellular phones and light emitting diodes, and lasers has spurred advanced process development of electronic materials. Increasingly, conventional wet processing has been replaced with plasma processing. Some advantages of plasma processing include precise control for critical specification, reproducibility, and high yield. Efforts in plasma processing have focused on GaAs, InP, GaN and other materials using conventional PECVD for deposition and reactive ion etching for pattern transfer. However, there were some challenges. Introduction of 2 MHz-based inductively coupled plasma (ICP) source for production of high density plasma have enabled us to overcome many issues for advanced plasma processing. One example is selective etching of GaAs over AlGaAs (or InGaP). A process for high selective, high rate, clean surface, vertical sidewall, good uniformity and minimal damage etching of GaAs/AlGaAs has been developed with the ICP source. The process is used in major production facilities for fabrication of heterojunction bipolar transistors (HBTs) and pseudomorphic high electron mobility transistors (PHEMTs). Another example includes via hole etching of GaAs. Via etching with high rate, selectivity and a vertical (or sloped) deep feature (> 80 micron) is easily achieved in the ICP reactor. Active research and development programs with the ICP source for InP and GaN plasma etching and dielectric material deposition are also under way in many important groups over the world. A goal of this talk is to present an overview of various challenges and exciting breakthroughs for plasma processing in RIE, PECVD and high density ICP reactors.

Dr. Jewon Lee has published over 150 journal and conference papers and presented over 30 talks on semiconductor processing at international technical meetings. He is a lead R&D engineer at Plasma-Therm, Inc., a manufacturer of advanced plasma processing equipment.