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Advanced Dry Etching of GaAs in High-Density Planar Inductively Coupled BCl3 Plasmas

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Infuctively Coupled high-density Plasma Etching is getting popular for precise pattern transfer for GaAs-based semiconductors, such as GaAs Heterojunction Bipolar Transistors (HBTs). Two dominant types of ICP source have been dveloped for processing. One is a cylindrical ICP source and the other is ea planar ICP source. We investigated dry etching of GaAs in a planar ICP reactor with BCl3 gas chemistry. The process parameters included planar ICP source power, chamber pressure, RIE chuck power and Gas flow rate. The ICP source power was varied from 0 to 500 W. Chamber pressure was changed from 5 to 20 mTorr. RIE chuck power was controlled from 0 to 150 W. The gas flow rate was varied from 10 to 40 sccm. We found that a process condition at 20 sccm BCl3, 300 W ICP, 100 W RIE and 10 mTorr chamber pressure gave an excellent etch result. The etched GaAs feature showed extremely smooth surface (RMS roughness < 1 nm), vertical sidewall, relevant fast etch rate (> 3000 Å/min) and good selectivity to a photoresist (> 3 : 1). XPS study on the surface of processed GaAs proved a very clean surface of the material after dry etching. We also noticed that our planar ICP source was successfully ignited both with and without RIE chuck power, which was generally not the case with a typical cylindrical ICP source, where assistance of RIE chuck power was required for turning on a plasma and maintaining it. It indicated that our planar ICP source could be a very versatile tool for advanced dry etching of damage-sensitive compound semiconductors. We will report the process results of planar inductively coupled BCl3 plasma etching of GaAs in detail in the presentation