Advanced Selective Dry Etching of GaAs/AlGaAs in High Density Inductively Coupled Plasmas

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We report a breakthrough for selective etching of GaAs over $Al_xGa_{1-x}As$, x = 0.2, etching with a high density plasma source. This results is particularly important for III-V devices such as HBTs or HEMTs. For example, fabrication of HBTs requires a process for selective etching of a GaAs contact layer while stopping on AlGaAs layer. Inductively coupled plasma (ICP) etching with $BCl_3/SF_6/N_2$/He chemistries showed extremely high selectivity of GaAs over AlGaAs (> 200 : 1) and a photoresist (> 10 : 1). This process also produced excellent sidewall passivation on GaAs with reasonablely high rate (> 1500 Å/min.). Both SEM and AFM data showed AlGaAs etch stop layer was quite smooth after processing. We found that He played a key role in enhancing selectivity and obtaining smooth AlGaAs surfaces. When used with resist masks, addition of N_2 into BCl_3/SF_6 plasma helped formation of passivation on the sidewall and maintained high anisotropy. An optimized condition with $BCl_3/SF_6/N_2$/He ICP plasmas showed excellent pattern transfer into GaAs with high rate, anisotropy and selectivity.