

Ohmic Contact on GaN HEMTs

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Recently, a Ti/Al/Mo/Au ohmic metallization system with a pretreatment of SiCl₄ plasma in a RIE system has demonstrated excellent ohmic electrical performance on both n-GaN and n-type doped AlGaIn/GaN surface [1]. Later, for Ti/Al/Mo/Au ohmic metallization system, its electrical performance related to the metal thickness evaporated and annealing condition has been optimized on the Undoped AlGaIn/GaN heterostructure without any plasma pretreatment [2].

We found that, based on the optimized Ti/Al/Mo/Au metallization system, it was harder to form ohmic contact with low contact resistance on doped AlGaIn/AlN/GaN heterostructure than on undoped AlGaIn/GaN material structure without AlN inter-barrier. Initially, because Ta has lower work function (4.25 eV) comparing to Ti (4.33 eV), and it has been shown that Ta can also react with N to form a TaN [3] and the outdiffusion of nitrogen from AlGaIn during annealing results in the formation of n-type doped layer under contacts, in this work, we present a Ta/Ti/Al/Mo/Au ohmic metallization system on undoped AlGaIn/AlN/GaN HFETs structure. The top four layers are fixed at Ti (15 nm)/Al (90 nm)/Mo (40 nm)/Au (50 nm). For Ta-based metallization system itself, the dependence of transfer resistance on the thickness of Ta was studied first. Based on this study, Ta/Ti/Al/Mo/Au and Ti/Al/Mo/Au metallization scheme were fabricated on the same chip and the results were compared with each other.

We have made a systematic study of Ta/Ti/Al/Mo/Au metallization scheme on undoped AlGaIn/AlN/GaN HFETs. A successful improvement in ohmic contact resistance using this metallization scheme was demonstrated compared to the standard Ti/Al/Mo/Au recipe. A contact resistance as low as 0.16 ± 0.03 ohm-mm, with a sheet resistance of 500 ohm/square, was obtained. Also, it showed good edge acuity under high temperature annealing.