DEVELOPMENT OF III-V SEMICONDUCTOR BASED INTEGRATED ON-CHIP HEMT DEVICES FOR RF POWER DETECTOR IN NANOSYSTEMS

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Explosive growth of internets and wireless technologies starting in the late 21st century has opened up prospects towards an advanced ubiquitous network society where nanoelectronic devices are the most promising candidate for such technologies. Therefore, those nanoelectronic systems are increasingly vulnerable to malfunction due to incident electromagnetic (EM) radiation, particularly since many integrated circuits operate at lower and lower voltages. The damaging RF radiation can be produced intentionally such as by high power microwave generator, or accidentally such as by ambient sources like lightning. Then, it becomes a great interest to know how, and at what level, microwaves penetrate equipment shielding and reach the vulnerable chips. This motivates our group to work on the on-chip RF detectors both for measuring power at the chip level and for developing strategies to mitigate its effects. Knowing the RF power levels in various chips and locations within chips is likely to be more useful than the “digital” information that a given external RF power level made the circuits fail. Schottky diode was designed and fabricated on n-AlGaAs/GaAs high-electron-mobility-transistor (HEMT) structure for RF power detection. The processing steps used in the fabrication were the conventional steps used in standard GaAss processing. Current-voltage measurements showed that the devices had rectifying properties with a barrier height of 0.5289 - 0.5468 eV. The fabricated Schottky diodes detected RF signals well and their cut-off frequencies up to 20 GHz were estimated in direct injection experiments. To achieve a high cut-off frequency, smaller Schottky contact area is required. The feasibility for direct integration with the planar dipole antenna via coplanar waveguide transmission line without insertion of matching circuits was discussed. Higher cut-off frequency also can be achieved by reducing the length of coplanar waveguide transmission line. These preliminary results will provide a breakthrough for the direct on-chip integration technology towards realization of ubiquitous network society.
Publications (Selected)


Conferences (Selected)


Awards

1. **Silver medal**, AlGaAs/GaAs Based On-Chip RF Power Detector, 11th Industrial Art & Technology Exhibition, INATEX 2009 UTM

2. **Bronze medal**, AlGaAs/GaAs Based On-Chip RF Power Detector, Malaysian Technology Expo 2010 (MTE 2010)