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Proton Irradiation Testing on Commercial Enhancement Mode GaN Power Transistor

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Abstract : Two basic equipment of electrical power subsystem of space satellites are Power Conditioning Unit (PCU) and Power Distribution Unit (PDU). Today, the main switching element used in power equipment in satellites is silicon (Si) based radiation-hardened MOSFET. GaNFETs have superior performances over MOSFETs in terms of their conduction and switching characteristics. GaNFET has started to take MOSFET's place in many applications in industry especially by virtue of its switching performances. If GaNFET can also be used in equipment for space applications, this would be great revolution for future space power subsystem designs. In this study, the effect of proton irradiation on Gallium Nitride based power transistors was investigated. Four commercial enhancement mode GaN power transistors from Efficient Power Conversion Corporation (EPC) are irradiated with 30MeV protons while devices are switching. Flux of $8.2x10^9$ protons/cm^2/s is applied for 12.5 seconds to reach ultimate fluence of 10^{11} protons/cm^2. Vgs-Ids characteristics are measured and recorded for each device before, during and after irradiation. It was observed that if there would be destructive events. Proton induced permanent damage on devices is not observed. All the devices remained healthy and continued to operate. For two of these devices, further irradiation is applied with same flux for 30 minutes up to a total fluence level of $1.476x10^{13}$ protons/cm^2. We observed that GaNFETs are fully functional under this high level of radiation and no destructive events and irreversible failures took place for transistors. Results reveal that irradiated GaNFET in this experiment has radiation tolerance under proton testing and very important candidate for being one of the future power switching element in space.

Keywords : enhancement mode GaN power transistors, proton irradiation effects, radiation tolerance
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