Université Lille Nord de France
Pôle de Recherche et d'Enseignement Supérieur

Ecole doctorale régionale Sciences Pour l'Ingénieur
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Titre Thèse	Nouveaux composants électroniques à base d'AlN pour les futures applications en électronique de puissance	
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Résumé du sujet :

Background

Wide Bandgap Semiconductors (WBG) such as SiC and GaN show superior material properties compared to Silicon. Due to these unique characteristics (high maximum current, high breakdown voltage, and high switching frequency), these WBG represent a tremendous opportunity to help solving the energy problems of the future. In this frame, the even wider bandgap but less mature material such as Aluminum Nitride (AlN, referred as Ultra-wide bandgap: UWBG) is also promising. AlN-based material system has a unique advantage due to its prominent spontaneous and piezoelectric polarization effects and flexibility in inserting appropriate heterojunctions thus dramatically broadening the device design space. Systems employing AlN-based devices could provide higher power efficiency, corresponding to lower losses, higher temperatures and higher switching frequencies, that allow reducing the size and weight of the converters.

Technical description

The overall objective of this proposal is to develop novel robust and reliable AlN-based power devices for high and medium power electronic systems targeting energy conversion efficiency applications and bringing the ultra-wide band gap (UWBG) semiconductors power devices another step towards the wide usability in the energy saving environment exploiting the full potential of this semiconductor material. In turn, the aim will be to explore and develop radically new material systems based on AlN ultra-wide bandgaps for future power devices providing higher robustness and superior temperature operation.

High crystalline AlN bulk material quality will be commercially purchased. Epilayers MBE growth will be performed by the partner CRHEA (Nice, France). Device design, fabrication and characterization will be carried out at CNRS-IEMN with the support of the University of Padova (Italy) in terms of advanced characterization.

Originality and Innovation

This program will push the boundaries of WBG technology by studying the implementation of AlN-based technology, which compared to GaN (and any other WBG semiconductor) has even better material properties. The ultimate goal of this proposal is to reach a breakthrough in the development of high voltage AlN transistors for application in power electronics

References

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