

MARSDEN FUND REFEREE REPORT – STANDARD APPLICATIONS

Referee number: 11
Application number: 07-UOW-004
Panel: Physical Sciences & Engineering
Principal Investigator: Professor JB Scott
Title: Unconventional wide-bandgap circuits

PLEASE READ THE INSTRUCTIONS IN THE GUIDELINES BEFORE COMPLETING THIS FORM.

- Please type or neatly print your report.

Section 1: REFEREE COMMENTS

REFEREE COMMENTS:

Please use the following headings, allocating as much space to each as you think is required:

1. Merit of the proposal

The research proposal details a proposed investigation into novel circuit applications of monolithic microwave integrated circuits (MMICs) fabricated on the Gallium Nitride (GaN) wide-bandgap compound semiconductor material. The proposal shows a high degree of originality in terms of the proposed circuit applications to be investigated. As the author states, GaN has principally been used to date for blue and white light emitting diodes (LEDs). In the microwave area, the bulk of research into device fabrication and MMIC design has focussed on power amplifier applications, a key application area being base station power amplifiers for wireless communication systems. To my knowledge, no work has been done to date on the applications cited in the application.

The proposed methodology for the research is very sound and the research programme should be achievable with the proposed staffing levels in the timeframe put forward in the application. The use of an external GaN foundry to provide the necessary design rules for the development of a CAD-based design kit is key to achieving the desired outcomes in the timeframe specified. The use of the external foundry facilities also makes experimental validation of the device models and circuit designs feasible within the cost and time constraints of the project.

The proposal clearly demonstrates that Professor Scott has an intimate knowledge of all aspects of MMIC design from device modelling through to circuit design. The planning outlined in the proposal shows a high level of insight into the problem and presents an excellent approach to the research, which also provides good opportunities for training higher degree by research students in the field of high frequency monolithic circuit design.

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**SECTION 1: REFEREE COMMENTS
(continued)**

2. Potential of the researchers to contribute to the advancement of knowledge

The researchers all have a long and distinguished track record in the fields relevant to this proposal. Professor Scott has an excellent mix of academic and industrial experience in the modelling and design of MMICs. His experience with Agilent Technologies, one of the world leaders in CAD and fabrication of Mimic's is particularly valuable. His publications are also all in the top journals and conferences in his field.

Professor Parker is probably the top person in Australia at present in the characterisation and modelling of microwave transistors. He has a long and distinguished track record in his field and again has a lengthy list of publications in the top journals and conferences in his field. He also has considerable industrial experience through his collaborations with US companies.

Mr Teetzel provides a wealth of practical design experience to the team and should ensure the success of the research project. His practical knowledge of MMIC design, fabrication and testing will be invaluable to the project.

In summary, I believe this is an excellent team which has a very high likelihood of making a significant contribution to the state-of-the-art in GaN MMIC design, and particularly to the development of novel circuit applications for this technology. The selection of circuit application areas which are very useful but outside the mainstream of current research work is a very attractive feature of this proposal.

3. Contribution to development or broadening of research skills in New Zealand, particularly those of emerging researchers.

A key feature of this proposal is the training of two PhD candidates and two MEng (by research) candidates. The combination of these graduates plus the expertise gained by the principal investigator in the project should form the foundation for a solid research group in GaN MMIC design within the University of Waikato. The expectation would then be that at least one of the PhD candidates would go on to take up a research fellow position at the University, thereby providing the key ingredient for the expansion of the group through the acquisition of further postgraduate research students. The group would also provide a focal point for attracting more academics to the University who wish to work in this exciting new area.

4. How could the proposal be improved?

I believe the proposal is of a high quality in its current form.