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Are the rare earth nitrides the future of spintronics?

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Diluted ferromagnetic semiconductors (DMS), which are formed by a dilute concentration of magnetic atoms incorporated into semiconductor materials, are seen as the most promising materials for spintronic device applications. To date the front runners are GaN and wide band gap materials doped with transition or rare-earth metals, based on the expectation of devices operating above room temperature. However although there have been a lot of progress over the last decade to accomplish this task, there is still a lack of complete understanding of the ferromagnetic exchange interaction. Furthermore growth issues such as the segregation of secondary phases or generation of defects when increasing the dopant concentration must still be overcome. On top of that, in such system the magnetic dopants tend to act as electronic dopants too making it difficult to control independently the carrier concentration and the magnetism. These problems have motivated to seek intrinsic ferromagnetic semiconductors. In this context the author has shown the rare-earth nitrides (RENs) appear as attractive alternatives; most of the fourteen REN elements combine the properties of the ferromagnet and the semiconductor, an exceedingly rare combination. It was also demonstrated that they are epitaxy compatible materials with group III-nitrides, the technologically important family for the fabrication of optoelectronic devices and high power transistors. Here, the author will take stock of where the progress has occurred within recent years in both the epitaxial growth and experimental field in view of developing proof-of concept spintronics device based on RENs and group-III nitrides.

Biography

Franck Natali has completed his PhD from the CRHEA-CNRS (France). Before joining Victoria University of Wellington, he spent 2 years as a Postdoctoral Fellow at the University of Canterbury in Christchurch, New Zealand, and 2 years in the R&D division of Riber, a world leading supplier of products and services to the compound semiconductor community. He is now a Lecturer in Physics at the Victoria University of Wellington and an Associate Investigator of The MacDiarmid Institute for Advanced Materials and Nanotechnology. He has published more than 60 papers in reputed journals.

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