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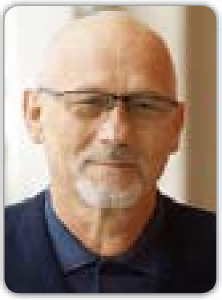


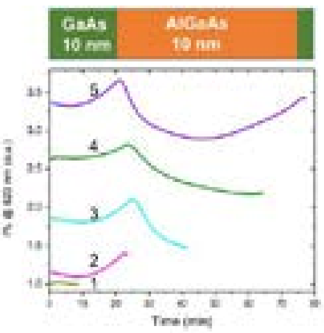
Jan J Dubowski

Interdisciplinary Institute for Technological Information (3IT)

Department of Electrical and Computer Engineering Université de Sherbrooke, Canada

In Situ Monitored Digital Photocorrosion of Semiconductors: Implications for Sensing and Diagnostics

Etching of semiconducting materials at the atomic level resolution is of high interest to technologies addressing fabrication of low-dimensional devices, tunability of their optoelectronic properties and precise control of device surface structure. The so-called digital etching that takes advantage of a self -limiting reaction was introduced almost 30 years ago for processing of Si devices. Today, the concept of digital etching has been reported for GaAs, GaAs/AlGaAs, GaAs p-n junctions, Ge1-xSix compounds, SiO2 SiN and some other materials. Conventional digital etching consists of a series of 2 cycles, each involving a limited or self-limited reaction step followed by a step designed to remove reaction products from processed surfaces. Typically, 0.1 – 1.5 nm of material is removed in each cycle, which is calculated based on post-processing measurements. The lack of diagnostics that would allow monitoring this process *in situ* is a significant drawback of such an approach. We have observed that for photoluminescence (PL) emitting materials, it is possible to carry out PL-monitored photocorrosion in cycles analogous to those employed in digital etching. The advantage of this approach is that photocorrosion of GaAs/AlGaAs nano-heterostructures could be carried in a water environment, or in any liquid that does not react with such materials in darkness. This digital photocorrosion (DIP) process could be carried out in cycles with sub-monolayer precision and simultaneously monitored with the PL signal. Recently, we have demonstrated that DIP could also be monitored *in situ* with open circuit potential (OCP) measurements. An excellent agreement between the position of GaAs/AlGaAs interfaces revealed during photocorrosion by PL and OCP suggests that the DIP process could be monitored *in situ* for materials with non-measurable PL.



Recent Publications

1. S. Aithal, N. Liu, J.J. Dubowski, "Photocorrosion metrology of photoluminescence emitting GaAs/AlGaAs heterostructures", J. Phys. D: Appl. Phys. 50, 035106 (2017).
2. E. Nazemi, W.M. Hassen, E.H. Frost, J.J. Dubowski, "Monitoring growth and antibiotic susceptibility of Escherichia coli with photoluminescence of GaAs/AlGaAs heterostructures", Biosens. Bioelectron., 93, 234-240 (2017).
3. H. Sharma, K. Moumanis, J.J. Dubowski, "pH-Dependent Photocorrosion of GaAs/AlGaAs Quantum Well Microstructures", J. Phys. Chem. C 120, 26129–26137 (2016).

4. M.R. Aziziyan, W.M. Hassen, D. Morris, E.H. Frost, J.J. Dubowski, "Photonic biosensor based on photocorrosion of GaAs/AlGaAs quantum heterostructures for detection of Legionella pneumophila", Biointerphases 11, 019301 (2016).
5. E. Nazemi, S. Aithal, W.M. Hassen, E.H. Frost, J.J. Dubowski, "GaAs/AlGaAs heterostructure photonic biosensor for rapid detection of Escherichia coli in phosphate buffered saline solution", Sensors and Actuators B207, 556-562 (2015).

Biography

Professor Jan J. Dubowski received his PhD degree in Semiconductor Physics from the Wroclaw University of Science and Technology, Poland. After spending almost 21 years at the National Research Council of Canada, in 2003 he joined the Université de Sherbrooke Department of Electrical and Computer Engineering where he coordinates research focused on nanotechnology of quantum semiconductors and their applications for life sciences. He is a Fellow of SPIE – the International Society for Optics and Photonics (citation: "For Innovative methods of investigation of laser- matter interaction"). He has published over 200 research papers, reviews, book chapters and conference proceedings. He is an associate editor of the Journals of Laser Micro/Nanoengineering, Biosensors and Light: Science & Applications

jan.j.dubowski@usherbrooke.ca

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