Site-controlled growth of GaN nanorods with inserted InGaN quantum wells on μ-cone patterned sapphire substrates by plasma-assisted MBE

© V.N. Jmerik[1], T.V. Shubina[1], D.V. Nechaev[1], A.N. Semenov[1], D.A. Kirilenko[1],
V.Yu. Davydov[1], A.N. Smirnov[1], I.A. Eliseev[1], G. Posina[2], S.V. Ivanov[1]

[1] Ioffe Institute,
194021 St. Petersburg, Russia
[2] Department of Physics, Chemistry and Biology (IFM), Linköping University,
S-58183 Linköping, Sweden
E-mail: jmerik@pls.ioffe.ru

We report on a new approach to fabricate regular arrays of GaN nanorods (NRs) with InGaN QWs by plasma-assisted molecular-beam epitaxy (PA MBE) on micro-cone patterned sapphire substrates (μ-CPSSs). A two-stage PA MBE fabrication process of GaN NRs has been developed, starting with a high temperature nucleation layer growth at metal-rich conditions to aggregate selectively GaN nucleus on c-oriented areas of the μ-CPSSs and followed by growth of 1-μm-thick GaN NRs at strongly nitrogen-rich conditions exactly on the cone tips. These results are explained by energetically favorable GaN growth on the $(000\bar{1})$ oriented sapphire surface. Both micro-photoluminescence and micro-cathodoluminescence confirm the formation of regular array of optically and spectrally isolated NRs without usage of any nanolithography.

Acknowledgements

This work has been supported by Russian Science Foundation, grant # 14-22-00107. The TEM measurements have been carried out with the use of equipment of the Federal Joint Research Centre „Material science and characterization in advanced technology“ (Ioffe Institute, St. Petersburg, Russia).