# Ultra-fast epitaxial growth of ZnO nano/microrods on a GaN substrate, using the microwave-assisted hydrothermal method

**B.S. Witkowski[1], P. Dłużewski[1], Ł. Wachnicki[1], S. Gierałtowska[1], B. Kurowska[1], M. Godlewski[1,2]**

[1]*Institute of Physics, Polish Acad. of Sciences, Al. Lotników 32/46, 02-668 Warsaw, Poland*
[2]*Dept. of Mathematics and Natural Sciences College of Science*
*Cardinal S. Wyszyński University, Dewajtis 5, 01-815 Warsaw, Poland*

Zinc oxide is extensively studied II-VI semiconductor with a direct energy gap of about 3.37 eV at room temperature and high transparency in visible light spectral region. Due to these properties, ZnO is an attractive material for applications in photovoltaic, electronic and optoelectronic devices. ZnO nanorods, due to a well-developed surface, have potential of applications in sensor technology. It is also increasingly common to discuss the potential use of such nanorods in random lasers, where the crystallographic quality is extremely important.

In this work we report well-aligned ZnO NRs (nano/micro-rods) with identical crystallographic orientation synthesized on c-plane GaN template using a microwave-assisted hydrothermal method at 50°C in time of 3 minutes. The ZnO NRs exhibit true hetero-epitaxial growth, in contrast to most of the previously reported methods, which involved the nucleation on a ZnO buffer layer pre-deposited on the substrate. Homogeneous in-plane alignment as well as a *c*-axis orientation were confirmed by, X-ray diffraction measurements and TEM analysis. More importantly, from photoluminescence spectra of the NRs strong and narrow excitonic emission and extremely weak deep level emission were observed, indicating that the NRs are of high optical quality. Diameter control of the well-oriented and high-quality ZnO NRs is mainly achievable by variation of the reaction solution used in growth process. The main achievement is to obtain orientation and high quality of ZnO NRs in a very quick, cheap and safe growth process that does not use poisonous or toxic substances and do not require high purity of used compounds.

In addition, TEM observations shown also that the NRs have the wurzite structure with stacking faults of the basal plane. Moreover, despite of low lattice constant misfit (1.9%) between ZnO and GaN, planes of GaN and ZnO are slightly inclined (of about 0.5 deg) each to other. It resulted in step of about 0,2 nm, what corresponds to the {00.2} interplanar distance. We believe the presented approach is a simple one for practical application of ZnO nanostructures to optoelectronic devices.

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