Paul-Drude-Institut für Festkörperelektronik

Master Thesis Topic

Top-down fabrication of (Al,Sc)N nanowires

Background & Motivation

The use of piezoelectric III-nitride nanowires is promising for the application in flexible piezoelectric energy harvesting. However, conventionally applied GaN and AlN nanowires provide rather low output signals. One way to improve the piezoelectric response of III-nitrides is to alloy them with transition metal nitrides, with ternary (Al,Sc)N being the archetypal example exhibiting five times the piezoelectricity of AlN. Nevertheless, fabricating (Al,Sc)N nanowires with a well-controlled morphology on large scale remains challenging.

Objective

The aim of this thesis is the development of top-down (Al,Sc)N nanowires with well-controlled morphology and evaluate them for the application in energy harvesting. First, the deposition and annealing of metallic layers on top of (Al,Sc)N thin films leads to the formation of self-assembled nano-islands, serving as a mask for nanowire fabrication by top-down etching. This metal-dewetting approach developed at the PDI will allow for well-separated nanowires to be fabricated on the wafer scale. Next, approaches based on electron-beam or laser lithography followed by etching will be employed to achieve highly organized nanowire ensembles.

Student's Role and Responsibilities

- Fabrication of novel nanowires using a combination of annealing, lithography and etching processes
- Characterization of nanowire morphology using scanning electron microscopy
- Structural characterization of fabricated nanowires using X-ray diffraction and Raman spectroscopy
- Data analysis and planning of experiments

Skills & Requirements

1. *Strong interest in experimental laboratory work, curiosity to learn new concepts and techniques*
2. *Interest in the field of inorganic semiconductors, especially nanowires*
3. *Good spoken and written English*

Opportunities and Benefits

- *Modern laboratories with access to state-of-the art equipment*
- *Supportive and collaborative environment with experts for various scientific sub-fields*
- *Close supervision enabled by a low number of students per advisor*
- *International and culturally diverse community*
- *Location in the heart of Berlin, financial support, subsidized travel tickets*

Contact

Dr. Philipp John
john@pdi-berlin.de
+49 30 20377362

For further details or clarification, please feel free to contact us. Lab tours are available for interested applicants.