Growth and electrical characterization of nanowires

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With the aim of downscaling semiconductor devices, a big effort has been devoted to growing and controlling semiconductor nanostructures such as nanoparticles, nanobelts or nanowires. Using these building blocks, nanolasers, nanogenerators, nanosensors, etc. have been already demonstrated.

Among the materials that have been used for growing such nanostructures, GaN and ZnO appear as current alternatives to Si/Ge and more classical III-V semiconductors, both sharing a wide band gap and a large exciton binding energy. These two properties render them interesting for optoelectronic applications working at room temperature in the blue and ultraviolet wavelengths regions. However, whereas GaN nanowires can be readily grown along several crystallographic directions, including the polar <0001> and the nonpolar <10-10> and <11-20> ones, ZnO nanowires growth seems to be restricted to the polar <0001> direction. In this communication we will review the state of the art concerning the growth of nonpolar GaN nanowires, and we will present different strategies for obtaining nonpolar ZnO nanowires.

One possible application of nonpolar wurtzite nanowires is the achievement of high electron mobility transistors, which can be designed on lateral facets of nonpolar core/shell nanowires. This structure, a mere example, shows the need of electrical contacting single nanowires, either to be powered by an external source or to transmit a detected signal, as in nanosensors. The electrical contacts should be scaled accordingly and, therefore, their size must be on the order of some nanometers or hundreds of nanometers. The most common method for contacting and studying such structures consists on lithographically defining the contacts on top of randomly spread nanowires. However, this process is time consuming and could damage the grown structures. In the second part of this communication we will present a detailed study on the formation and rupture of Schottky nanocontacts on ZnO by conductive scanning force spectroscopy, a technique which does not require the removal of the nanowires from their original substrate. This method, which relies on the simultaneous acquisition of *IV* curves and the loading force applied to a conducting tip, allows to analyzing in parallel the electrical and mechanical properties of the contact and, thus, provides reliable transport properties from the as-obtained nanowires.