Among the different ZnO nanostructures, nanowires (NWs) are of particular interest for applications: they are envisioned as possible future building blocks for nanoelectronics [1] due to their well-defined geometry and possibly enhanced electronic transport properties, coupled with size-dependent piezoelectric response [2]. It is of great importance to understand how the electronic transport behavior of the NWs is influenced by morphology and crystalline structure on one side, and by the particular approach adopted for the implementation of electrical contacts at the nanoscale on the other side. Electrical measurements on single NWs have been reported in literature, with resistivity values ranging over many orders of magnitude ([3,4]), depending on the synthesis techniques, morphology, crystalline structure and defects, type of electrical nanocontacts, ambient conditions and experimental set-up. Therefore, work still needs to be done in order to gain fundamental understanding of the electrical properties of single ZnO NWs and their relationship with synthesis and structure.

In this work we report on the structural, morphological and electrical characterizations of ZnO NWs by means of Field Emission Scanning Electron Microscopy (FESEM), Transmission Electron Microscopy (TEM) and two-probe I-V measurements performed in-situ by the dual-beam FIB-FESEM system. The ZnO NWs were grown by low-pressure chemical vapor deposition (LPCVD) on Si wafers. The morphology of the samples was initially characterized by FESEM: the aspect ratio and the homogeneity of the cross-section along the whole NWs were evaluated. High-resolution TEM characterization shows that the NWs are wurtzite single crystals and they are oriented along the [001] crystalline direction. In order to perform electrical measurements, the NWs were detached from the Si substrates, ultrasonically dispersed in ethanol and then transferred onto SiO$_2$ substrates for the subsequent preparation of metallic contacts. FIB-induced deposition of Pt pads from a gas precursor (methylcyclopentadienyl-trimethyl platinum) was carried out and two-probe measurements were performed in the dual-beam chamber by direct contact of two micromanipulators on the deposited Pt contacts. In the case of NWs with suitable length (> 4 µm), the deposition of more than two contacts was considered to perform transmission line measurements in order to gain information about the contact resistance.

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