

SSNN O8 GaAs NANOWIRES OBTAINED VIA ELECTROCHEMICAL ETCHING OF BULK SUBSTRATES

Ed. Monaico^{1,*}, V. Morari², V.V. Ursaki², E.I. Monaico¹, I.M. Tiginyanu¹, K. Nielsch³
¹National Center for Materials Study and Testing, Technical University of Moldova, Chisinau, Moldova; ²Institute of Electronic Engineering and Nanotechnologies "D. Ghitu", Chisinau, Moldova; ³Leibniz Institute for Solid State and Materials Research (IFW Dresden), Institute for Metallic Materials (IMW), Dresden, Germany
*E-mail: eduard.monaico@cnstm.utm.md

Technological conditions for obtaining InP nanomembranes and nanowires by means of fast anodic etching of bulk substrates have been recently elaborated [1-3]. Electrochemical etching is an easy, cost-effective, and very fast technology, as compared to other methods. Micrometer long InP nanowires can be obtained in several seconds. Other methods employed for growing semiconductor nanowires have a drawback of incorporating various crystallographic defects due to impurities from electrolytes, precursors and different transport gases in the growth process. The main advantage of electrochemical etching technology relies on the fact that the quality of the produced nanowires and ultrathin walls is similar to that of the initial crystalline substrate.

In this paper, we present results on preparation of triangular GaAs nanowires by one step anodic etching of bulk GaAs substrates. The technological parameters of anodic etching of GaAs crystals with different crystallographic orientations (111) and (001) were optimized. The following electrolytes have been used in this study: HCl, HNO₃, HBr, and environmentally friendly aqueous electrolyte based on NaCl. It should be noted that the obtained GaAs nanowires represent triangular prisms, in contrast to cylindrical shaped nanowires produce by traditional technologies. It was found that the diameter of nanowires is controlled by the concentration of the electrolyte and the applied voltage. Nanowires with the same crystallographic orientation can be obtained on the basis of bulk crystals with different crystallographic orientation. The difference is that the nanowires produced on (111)B GaAs substrates are oriented strictly perpendicularly to the substrate surface, while those obtained on (001) GaAs substrates are tilted in the direction parallel to the substrate surface. The length of nanowires, e.g. those obtained after 40 min etching of (111)B GaAs substrates, is around 260 μm.

It is shown that crystallographic orientation has a huge influence on electrochemical etching. It was established that during the electrochemical etching of (001) GaAs crystals the nucleation occurs in the form of a rectangle, while in the (111) B substrates it is triangular.

We present also results on the investigation of opto-electrical parameters of GaAs nanowires with different diameters and crystallographic orientation. For this purpose, the nanowires were dispersed in ethanol and few drops of the suspension of ethanol with nanowires were deposited on a glass substrate. The contacts have been deposited by two different approaches. In the first case, laser beam lithography was used. Consequently, Cr/Au contacts were deposited on individual nanowires by means of magnetron sputtering. In the second approach, prefabricated Si/SiO₂ chips with Au contacts have been used.

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