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Electrochemical impedance spectroscopy for characterisation of templated nanowire arrays

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Semiconducting nanowires are promising structural elements for application in the various devices as photodetectors, solar cells and sensors [1, 2]. For these applications, nanowire electrical properties and their incorporation within architectures as porous templates are critical. So far, several comprehensive characterisation methods, for example, conductive atomic force and scanning electron microscopy, have been used for templated nanowire arrays study. These methods can be employed for small areas of the sample. To extract the electrical and morphological information of the nanowire arrays, one has to use the combination of several methods. Instead, electrochemical impedance spectroscopy (EIS) may be used to characterise large area samples providing both electrical and morphological information. Previously, EIS have been widely applied for porous electrodes characterisation. Nanowire arrays have not been studied using this method. Here we have adapted EIS for complex characterisation of nanowire arrays embedded into porous templates. In this work, Bi2S3 nanowires grown within anodized aluminium oxide (AAO) templates were studied. For sample characterisation, nanowire filled membranes were polished and gold macro electrodes were evaporated onto one side of each membrane. We have determined the EIS operational conditions and equivalent electrical circuits to calculate the electrical parameters for nanowires. Using our approach, nanowire filling density into the template can also be evaluated. The characterisation has been performed on the with Bi2S3 nanowires filledand empty AAO templates, but it can be used for any other AAO-templated nanowire arrays.

References1. A.D. Schricker, M.B. Sigman, B.A. Korgel, Nanotechnology, 16, S508 (2005).2. H. Bao, C.M. Li, X. Cui, Q. Song, H. Yang, J. Guo, Nanotechnology, 19, 335302 (2008).

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