

# SYNTHESIS OF NI NANOWIRES BY ELECTRODEPOSITION FROM DEEP EUTECTIC SOLVENT

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Nickel or nickel-based nanomaterials are widely considered as an electrode material for electrochemical capacitors [1] and water-splitting systems [2]. Among different structures one of the most beneficial seem to be nanowire arrays; their popularity stems from their highly ordered structure, large working surface area and high surface to volume ratio. The possibility to synthesise them directly on a conducting substrate, without additional binders, is another advantage.

Nanowire arrays are often synthesised by template-assisted electrodeposition, usually with porous anodic aluminium oxide (AAO) membranes as templates [3]. Typically, aqueous solutions are used; unfortunately, they have several limitations, including narrow potential windows and the risk of hydrogen evolution occurring simultaneously with metal deposition, which can result in brittle, spongy Ni structures [4,5]. One of the ways of overcoming these drawbacks is using non-aqueous solutions; among them, so-called deep eutectic solvents (DESs) are becoming more and more popular. This is because of their advantageous properties: extended potential window, relatively low toxicity, easy synthesis and little to no need for purification before electrodeposition [5,6], just to name a few. It has been shown that it is possible to obtain high quality nickel films of uniform thickness and low roughness under simple potenti- or galvanostatic regime from a DES based solution. This research aims to show that similar setup can be used to synthesize Ni nanowire arrays of good quality.

Nickel nanowires were electrodeposited in AAO templates sputtered with a thin Au film on one side. As a non-aqueous solvent, a mixture of choline chloride and

ethylene glycol in molar ratio 1:2 with Ni concentration of 1.14 M was used. The electrodeposition was performed for 1 hour at 70 °C under potentiostatic ( $E = -0.7$  V,  $-0.8$  V or  $-0.9$  V vs.  $\text{Fc}/\text{Fc}^+$ ) or galvanostatic ( $j = -1$  mA/cm<sup>2</sup> or  $-2$  mA/cm<sup>2</sup>) regime. The process was carried out in a three-electrode cell, with the AAO template, platinum coil and platinum wire as the working, counter and pseudo-reference electrodes, respectively. The morphology and chemical composition of as-obtained nanowires were examined using scanning electron microscopy (SEM) and energy-dispersive X-ray spectroscopy (EDS).

### Acknowledgements

This work was supported by the National Science Centre Poland [Grant No. 2017/26/M/ST5/00715].

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