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Production and characterization of electroactive nickel oxides on nickel foam and self-standing nickel nanowires by anodic oxidation in molten salt for supercapacitor electrodes

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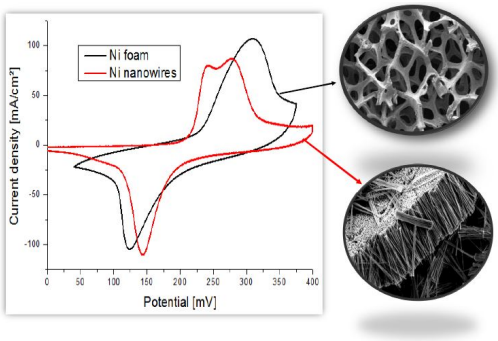
Abstract

Statement of the Problem: Nickel oxides, hydroxides and oxyhydroxides are promising materials for supercapacitor applications due to their high specific capacity. While indirect production of these nickel based materials is achieved either by chemical or electrochemical routes, the direct production on nickel metal itself has proved challenging. However, direct production should be investigated because it would facilitate the electron transfer required for redox reactions on the electrode surface, leading to much higher capacitances than those of the electrodes prepared with mixing nickel based materials and polymer blends.

Methodology & Theoretical Orientation: In the previous studies conducted in our group, we adapted molten salt electrolysis in KOH to directly synthesize nickel oxides on Ni foam. Here, we use the optimum parameters to synthesize nickel oxides on Ni foam and self-standing nickel nanowires (Ni NW) produced by electrodeposition in AAO templates. These structures are characterized by XRD, SEM and Raman spectroscopy. The structure and the capacitance behavior is determined by cyclic voltammetry (CV) and chronopotentiometry in 6M KOH solution.

Findings: After anodic oxidation, Ni foam and Ni NWs exhibit comparable capacitance behavior and moreover, the inherent capacitance of the Ni NWs is also increased.

Conclusion & Significance: Ni NWs are promising material group for supercapacitor applications similar to Ni foams when they are anodically oxidized by using optimized parameters.



Recent Publications

1. Tokmak, N. and Ürgen, M. 2017. "Production and Characterization of Electroactive Nickel Oxides Grown on Nickel Foam by Anodic Oxidation in KOH Melts for Supercapacitor Application". *MRS Advances* 2 (54), 3237-3247.
2. F. Bayata, Z. Beril Akinci, A. Senem Donatan, Mustafa Urgen "A novel free-standing nanowire substrate with surface enhanced Raman scattering (SERS) activity" Materials Letters, Volume 67, Issue 1, 15 January 2012, Pages 387-389.
3. F. Bayata and M. Ürgen, "Role of aluminum doping on phase transformations in nanoporous titania anodic oxides," *J. Alloys Compd.*, vol. 646, pp. 719–726, Oct. 2015.
4. F. Bayata, B. Saruhan-Brings, and M. Ürgen, "Hydrogen Gas Sensing Properties of Nanoporous Al-Doped Titania," *Sensors Actuators B Chem.*, vol. 204, pp. 109–118, Jul. 2014
5. Z. B. Akinci and M. Urgen, "A Simple Method for the Production of AAO Templates for DC Electrodeposition of Nanostructures," *ECS Electrochem. Lett.*, vol. 3, no. 10, pp. D46–D49, Aug. 2014



Biography: Prof. Dr. Mustafa URGEN is presently working in the Metallurgical and Materials Engineering Department of Istanbul Technical University and leading the "Surface Technologies" group. He has more than 130 journal and conference publications. He received best paper award from IMF (International Metal Finishing Society) - Jim Kape Memorial Medal. The innovative coating he has developed in collaboration with Dr. Ali Erdemir (ANL, Chicago-USA) has received the R&D 100 award in 2009. He has given over 25 invited talks in national and international meetings. He took part as chair and organization committee member in numerous national and international meetings. Prof. Urgen has directed several government and industry-sponsored projects and took part in EU funded projects. His research interest areas are: electrolytic, diffusion, PVD and Hybrid-PVD coatings, corrosion, nanopatterning of surfaces and energy materials. He is one of the authors of 5 issued and 4 pending patents.

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