Electrochemical Evaluation of Low-Cost Flexible Supercapacitors Based on Nickel-Coated Activated Carbon Textile Electrodes

Paola G. Vilchis-Gutiérrez[a,b], José A. Ávila-Niño[c*], Ma. Dolores Durán-García[a*], Marquidia J. Pacheco-Pacheco[d], and Iván G. Martínez-Cienfuegos[a].

[a] *Universidad Autónoma del Estado de México, Cerro de Coatepec s/n, Ciudad Universitaria, Toluca, Estado de México, 50000, México.*
[b] *CIDETEQ Centro De Investigación y Desarrollo Tecnológico en Electroquímica, S.C., Parque Tecnológico Querétaro s/n, Pedro Escobedo, Querétaro, 76703, México.*
[c] *Secretaría de Ciencia, Humanidades, Tecnología e Innovación (Secihti) -CIATEQ Centro de Tecnología Avanzada, Nodo Servidor Público 165, Anexo al Club de Golf, Las Lomas Zapopan, Jalisco, 45131, México.*
[d] *Instituto Nacional de Investigaciones Nucleares, Carretera México Toluca-La Marquesa s/n, Ocoyoacac, Estado de México, 52750, México.*

Supplementary Information

Scanning Electron Microscopy

The micrographs of the nickel-containing electrodes with 1 carbon ink immersion are shown in Figure S1, and they are organized according to the different coating times and the elemental mapping, where the nickel content for each treatment is highlighted.

It is observed that at 15, 10, and 3 minutes of Ni deposition, the nickel coating covers a large area of the carbon material, unlike those subjected to 1 minute of Ni deposition. Both carbon ink immersion and Ni deposition have an impact on the storage capacity of the electrodes, because they are key features in the surface area [15,17]. By performing Energy Dispersive X-ray spectroscopy (EDS), we found that Ni content was increasing due to the time deposition increment as follows: 0.44, 7.57, 9.81, and 27.15 at % for 1, 3, 10, and 15 minutes of Ni deposition, respectively.

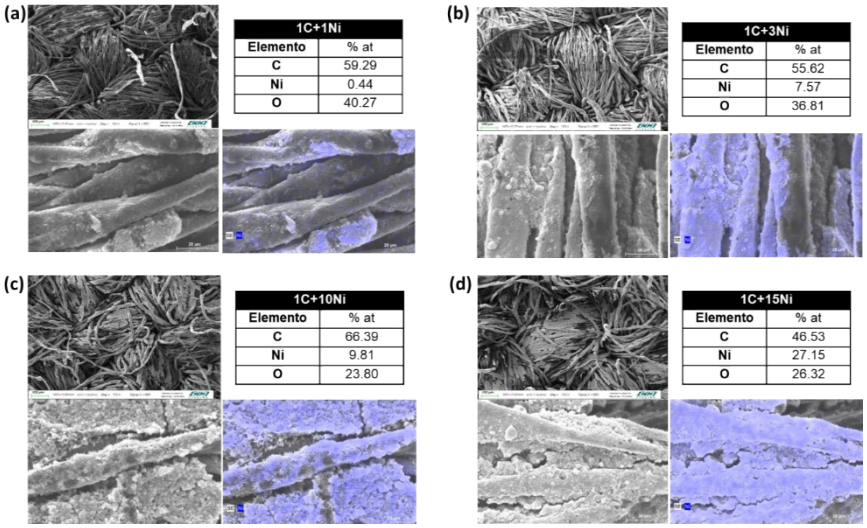

Figure S1. Micrographs, Ni mapping and elemental composition of electrodes: (a) 1C+1Ni, (b) 1C+3Ni, (c) 1C+10Ni and (d) 1C+15Ni.

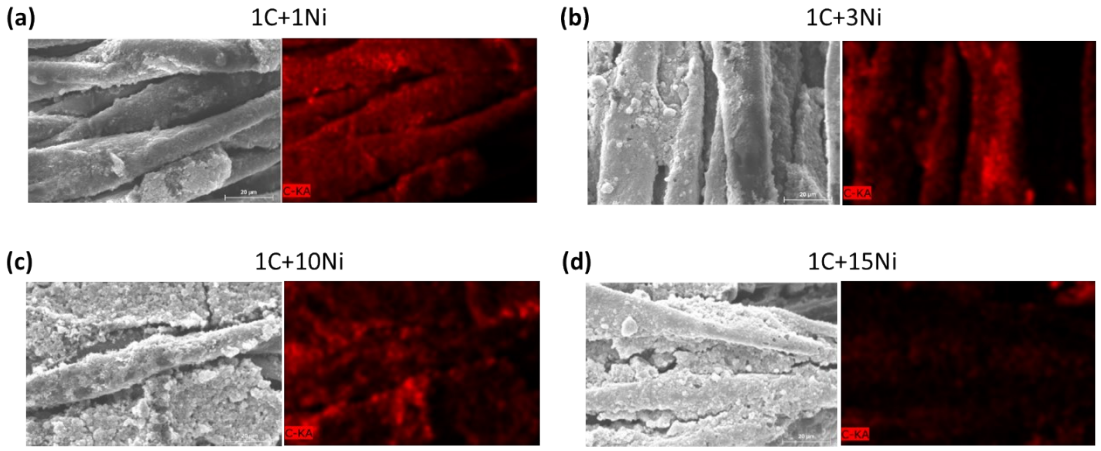

Figure S2. Carbon mapping of electrodes: (a) 1C+1Ni, (b) 1C+3Ni, (c) 1C+10Ni and (d) 1C+15Ni.

Galvanostatic charge-discharge

The galvanostatic charge-discharge tests were carried out by subjecting the prototypes to different currents, from 2 milliamperes to 10 milliamps, which were transformed into units per area (mA·cm-2) considering the electrode area, which is 3.14 cm^{-2}. The curves obtained are presented below.

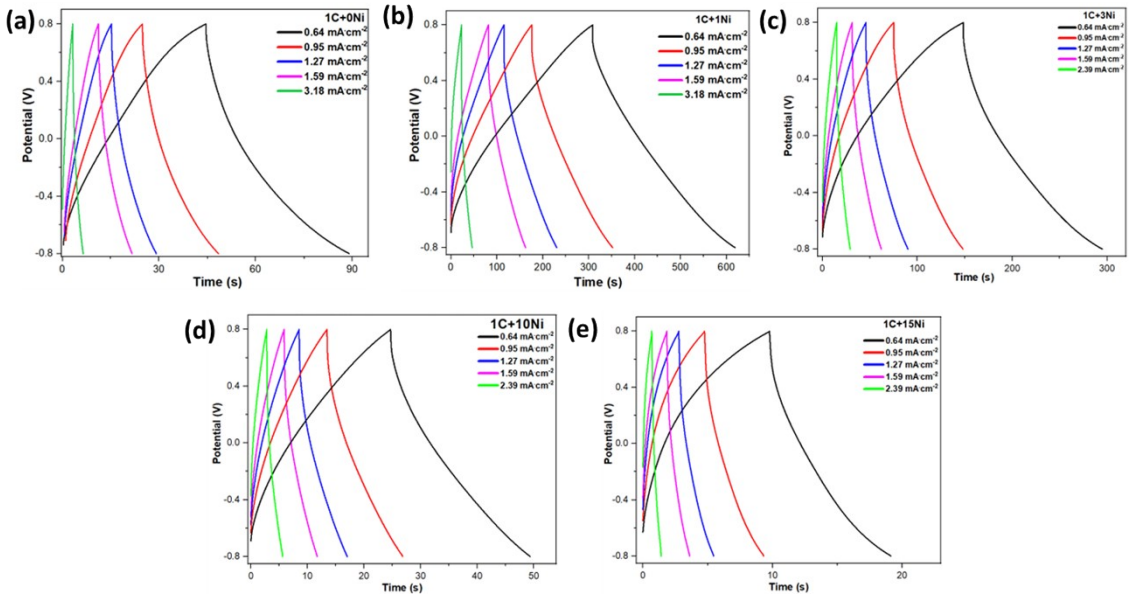

Figure S3. Electrode charge-discharge curves: (a) 1C+0Ni, (b) 1C+1Ni, (c) 1C+3Ni, (d) 1C+10Ni, y (e) 1C+15Ni.

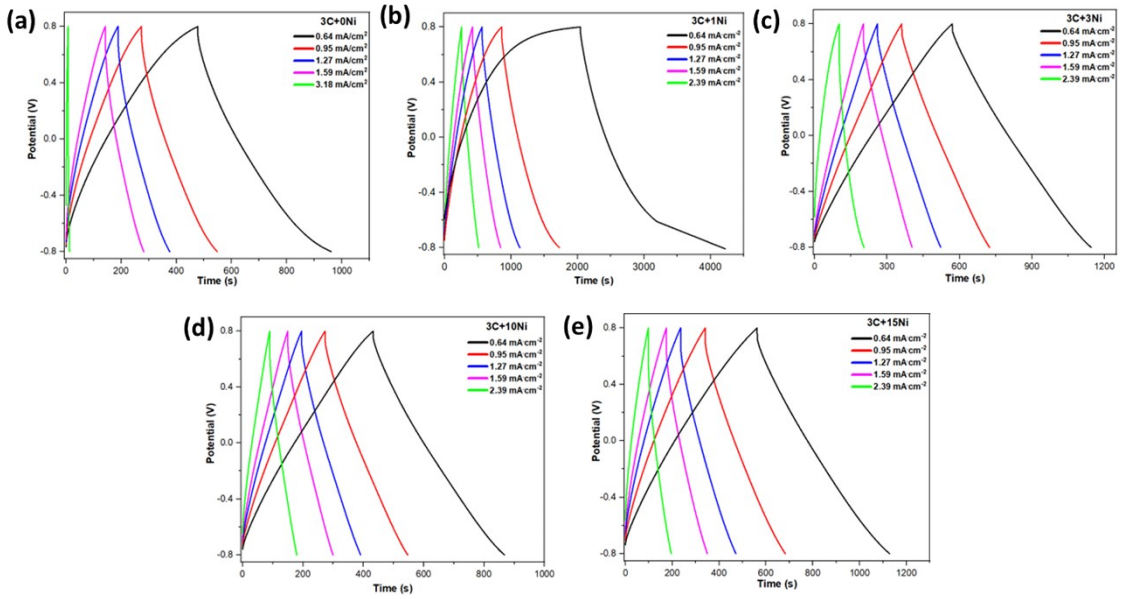

Figure S4. Electrode charge-discharge curves: (a) 3C+0Ni, (b) 3C+1Ni, (c) 3C+3Ni, (d) 3C+10Ni, y (e) 3C+15Ni.

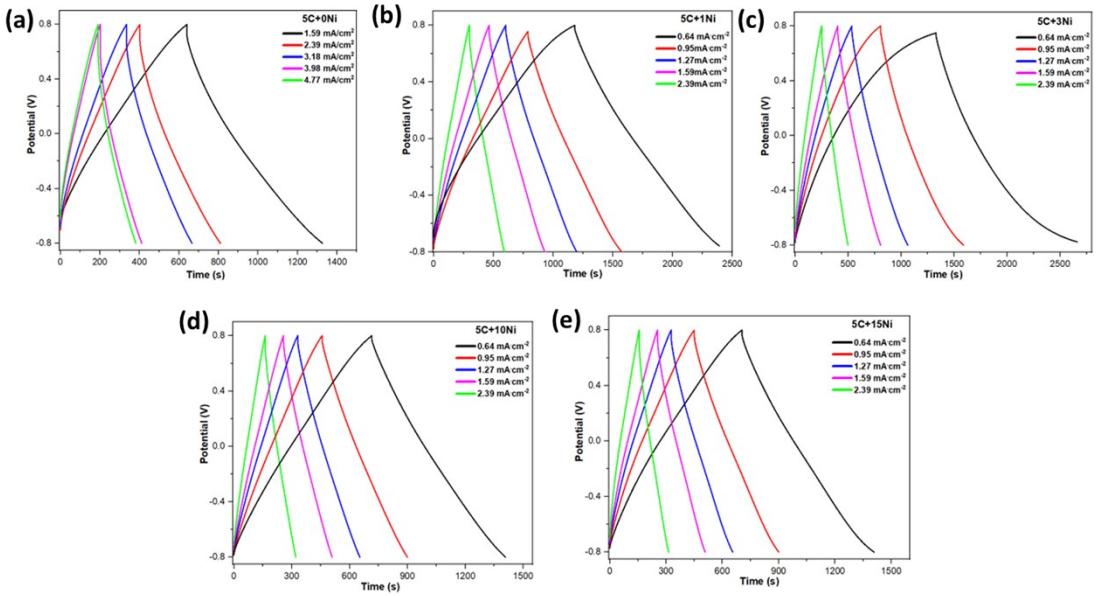

Figure S5. Electrode charge-discharge curves: (a) 5C+0Ni, (b) 5C+1Ni, (c) 5C+3Ni, (d) 5C+10Ni, y (e) 5C+15Ni.