Title	**Cathodic hydrogen evolution in acidic solutions using electrodeposited nano-crystalline Ni-Co cathodes**
Authors	W.A. Badawy, H. Nady, **M. Negem**
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Abstract

Nano-crystalline Ni and Ni-Co electrodes were prepared by electrodeposition on copper substrates. The obtained materials were characterized morphologically and chemically by XRD and scanning electron microscopy, SEM, coupled with EDX analysis. The incorporation of Co into the Ni matrix causes surface modification, which catalyzes the hydrogen evolution reaction, HER. The electro-catalytic performance of the prepared electrode layers was studied by means of polarization techniques and electrochemical impedance spectroscopy, EIS, in acidic solutions. The Results reveal a decrease in the hydrogen overpotential by increasing the Co content up to 50 at% in the deposited cathode layer. The Nyquist impedance plots of the different investigated materials at different potentials in the hydrogen evolution region showed a single semicircle, which means that a single time constant is controlling the HER. Ni-Co deposits with 50 at% Co contents show the highest rate of hydrogen evolution as a consequence of the synergetic combination of Ni and Co. The increase of the Co content more than 50 at% was accompanied by a decrease in the rate of HER. The low hydrogen over-potential and high hydrogen adsorption on the Ni-50 at% Co is attributed to the synergetic effects of Co and Ni together.