**Transformation of One Step Two Electron Transfer Ni Reduction and Oxidation Process to Two-step One Electron Transfer Process**

***Salih Cihangir1,2\*[C:\Users\Abdullah\AppData\Local\Microsoft\Windows\INetCache\Content.Word\ORCID-iD_icon-16x16.gif](https://orcid.org/0000-xxxx-xxxx-xxxx)*** ***0000-0001-5989-5230***

*1I* *Tunceli Vocation School, Department of Chemistry and Chemical Processes, Munzur University, Tunceli, Turkey*

*2Rare Earth Elements Application and Research Center, Munzur University, Tunceli, Turkey*

|  |
| --- |
| **Abstract**  In this study, the electron transfer process of nickel cation in deep eutectic solvent formed by mixture of 1 molar choline chloride and 2 molar urea, commercially known as Reline, were altered from one step 2e- transfer to two-step e- transfer process at both reduction and oxidation zones. Nickel was already studied in Reline, and revealed clear single peaks in both reduction and oxidation zones at around -1.4V and 0.2V, respectively, at 20 oC in three electrode (Pt working electrode, Ag/AgCl reference electrode, Pt counter electrode at 20 mV.s-1) cyclic voltammetry experiments [1]. When a three electrode configuration (Pt working electrode, Pt counter electrode, and pseudo Ag wire as reference electrode) was applied for cyclic voltammogram experiments at 50 oC in 0.1M ammonium chloride added 0.1M NiCl2 dissolved Reline solution, the reduction and oxidation of nickel turned into two-step one electron process. When peaks in reduction and oxidation regions were analyzed, it was found that Ni2+/+ reduction occurred at -0.6V, Ni+/0 reduction occurred at -0.8V, Ni0/+ oxidation occurred 0.15V, and Ni+/2+ oxidation occurred at 0.4V. Performed study were confirmed by optical confocal microscopy by taking images of working electrode at each peak. While there was no nucleation observed on the surface of electrode taken out at exactly -0.6V, a clear nickel flakes were observable on the surface of electrode taken out at -0.8V. In the oxidation zone, the nickel deposited electrode was taken out at 0.15V for surface observation, and no nickel nucleates were observed. Providing a wider stable potential window for formation of solid nickel phase can allow sufficient time for species to diffuse into the double layer before final reduction takes place. Therefore, performed study can be particularly useful for nickel alloy formation with other transition metals or in synthesis of Ni+ bonded nickel complexes. |
| Keywords: Cyclic voltammetry, deep eutectic solvents |

**References**

[1] A. P. Abbott, K. El Ttaib, K. S. Ryder & E. L. Smith (2008). Electrodeposition of nickel using eutectic based ionic liquids, *Transactions of the IMF*, *86*(4), 234-240.