EDS Analysis of unprepared Nickel mesh used for Mizuno type excess heat energy production LENR experiments

Peter Bjorkbom
NEOFIRE Research Laboratory
Sweden
http://www.neofire.com
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Abstract— **This is an Energy Dispersive Spectroscopy (EDS) analysis of a type of Nickel mesh material used in the area of excess heat energy production experiments (LENR, Low Energy Nuclear Reactions).**

Work is a continuation of investigation of a sample that has been described by this investigator in a previous paper [3].

The sample being analysed is of a type used in excess heat reactor experiment described by T.Mizuno and J.Rothwell and the sample originates from the same batch (mesh roll) as used in Mizunos experiments that has been reported to yield excess heat.

Sample material is unprepared meaning it is as-received from the manufacturer of the mesh.

I. Background

Emerging from experimental research in hydrogen and deuterium loaded metals are possible novel exothermic reactions that take place under certain experimental conditions.

These novel reaction mechanisms, Low Energy Nuclear Reactions (LENR), indicate possible yields of excess energy at orders of magnitude larger than ordinary chemical reactions and that positions LENR as an intermediary between chemical and nuclear energy in terms of energy density per mass unit.

Theory behind LENR phenomena are poorly understood and the field is currently driven by experimental research. There are likely several mechanisms at play in LENR, possibly augmented by material surface properties and chemical conditions.

The current work is part of a larger body of research conducted by the investigator on materials used in LENR experiments, with ultimate objective the advancement of understanding of LENR phenomena.

II. Objective

Objective of this analysis is to characterize the elemental composition of, a Mizuno type, LENR material surface in its as-received state, before preparation steps and before being subjected to LENR reactor experiments.

Current work is a continued investigation of the sample that has been described in a previous paper [3].

Results are intended to serve as reference for continued future investigations of material samples coming from the same batch, after preparation steps and after being subjected to LENR reactor experiments.

III. Material

A. Source

The sample of material being analysed, is the same as in [3], and originates from Mizuno in Japan and is from the same batch (mesh roll) as used in his experiments yielding excess heat as prevoiusly reported by Mizuno and Rothwell.

B. Overview

Sample is a 20x20 mm piece of Nickel-200, twill wire mesh, 0.055 mm diameter x 180 mesh. Sample was cut out of a larger sheet (300x300 mm) of the mesh by the investigator.

Bulk material of mesh is specified as Nickel-200 (UNS N02200/W.Nr. 2.4060 & 2.4066) and is commercially wrought nickel.

Limiting chemical composition for Ni-200 can be found in [3].

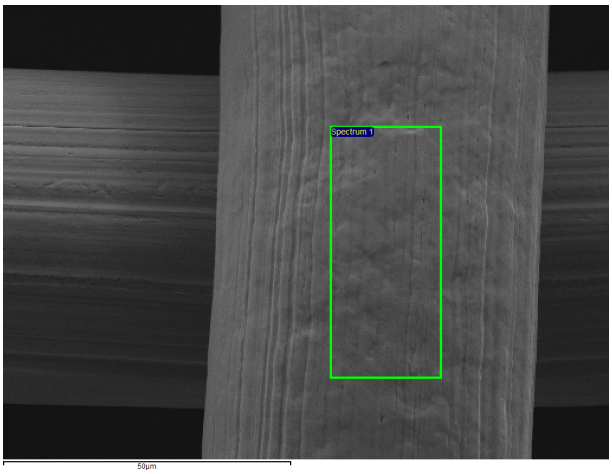

Fig. 1. Wire: Region on top of Nickel wire. 'Spectrum1'

IV. Methods

Energy Dispersive Spectroscopy (EDS) to map spectra of elemental composition on surface of mesh. Two maps of spectra will be used, one for an overview of a larger section of mesh and one of a selected area of a wire.

V. Preparation

Sample was cleaned, from hydrocarbons, submersed in a beaker with Methyl-alcohol in ultrasonic bath for 5 minutes. Sample was dried from Methyl-alcohol by blowing with high-purity Nitrogen gas prior entry into SEM/EDS instrument.

VI. Results and Discussion

EDS spectra was aquired with a Oxford Instruments INCA Energy 450 inside a Zeiss Ultra 55 FEG-SEM instrument.

A. Spectra of mesh section

At first a spectra of a larger section of the Nickel mesh was aquired. Elements detected where Ni, O, C, Si, S and Al. All of these except Al are to be expected according to specification of a Ni-200 material. Table I lists the elements and their concentrations (normalized). Figures 3, 4, 5, 6, 7, 8 show spectra map of these elements.

1) Carbon: Carbon is present in large amount in the mounting sticker underneath the mesh and show up in the spectra between the wires. Any Carbon signal from the wires of the mesh is not possible to detect in this situation.

TABLE I

EDS Specta overview section

Ni	72.62
C	25.61
O	1.39
Al	0.13
Si	0.15
S	0.10
Total	100

TABLE II

EDS Spectra of selected region on wire. 'Spectrum 1'

Ni	98.54
C	0.95
O	0.0
Al	0.23
Si	0.24
S	0.05
Total	100

2) Aluminum: Aluminum is present on the wires.

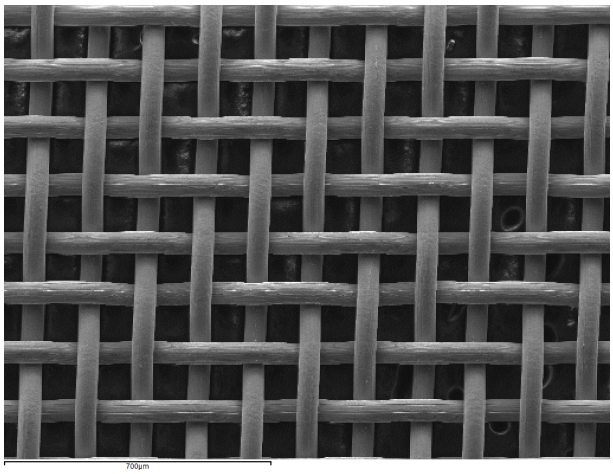

Fig. 2. Mesh: Section of Nickel-mesh analysed by EDS.

B. Spectra of wire

Secondly a spectra of a selected area on top of one of the wires of the Nickel mesh was acquired. Elements detected where Ni, O, C, Si, S and Al. All of these except Al are to be expected according to specification of a Ni-200 material. Table II lists the elements and their concentrations (normalized). Figure 1 show region on top of wire selected for spectra 'Spectrum1'.

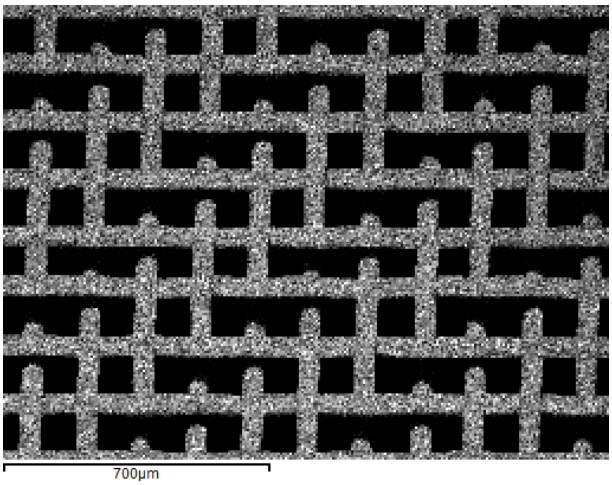

Fig. 3. Mesh: Nickel in wires.

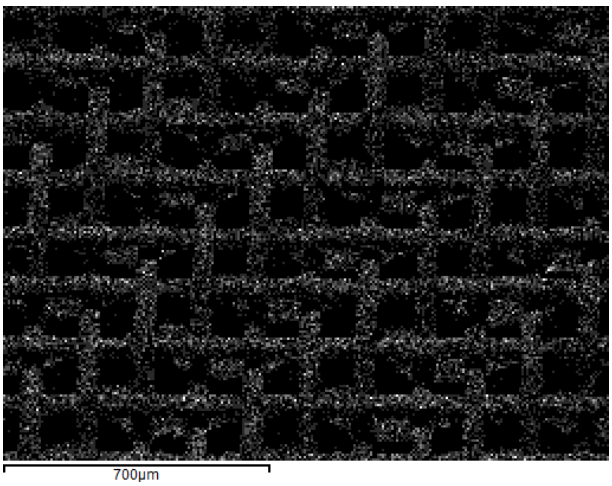

Fig. 4. Mesh: Oxygen is present in the wires.

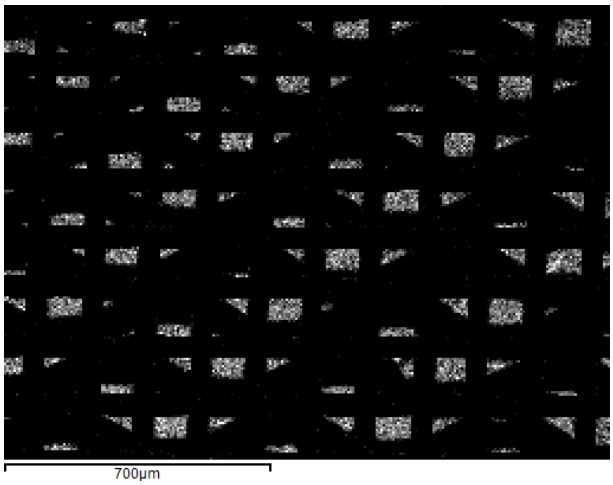

Fig. 5. Mesh: Carbon is present in between the wires of the mesh at the sticker that sample was mounted to.

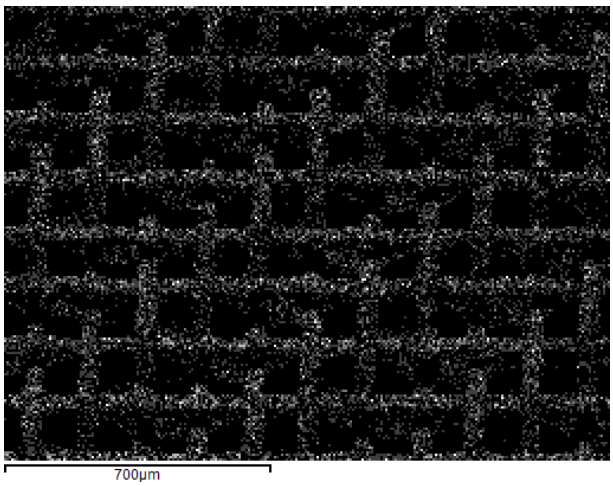

Fig. 6. Mesh: Silica is present in the wires.

1) Chemical composition: Elemental composition of wire surface of mesh are in line with expectations for industrial grade bulk Ni-200 material. A more sensitive method for determining elemental contents at surface and in bulk is required for further investigations.

2) Carbon: Carbon is present on wire surface and that can be attributed to hydrocarbons contamination. A more sensitive method for determining elemental contents, and possibly also molecular fragments of hydrocarbons, at surface and in bulk would be required for deeper insights into the origin of the Carbon.

VII. CONCLUSIONS

Elemental composition of wire surface of mesh are in line with expectations for industrial grade bulk Ni-200 material. A more sensitive method for determining elemental contents at surface and in bulk would be of interest in future investigations.

A comparative analysis of similar Nickel mesh materials from other manufacturers of bulk material/wire/mesh would be of interest for further analysis in future investigations.

REFERENCES

[1] Tadahiko Mizuno, Jed Rothwell, 2019. Supplemental Information on Increased Excess Heat from Palladium Deposited on Nickel.

[2] Tadahiko Mizuno, Jed Rothwell, 2019. Increased Excess Heat from Palladium Deposited on Nickel

[3] Peter Bjorkbom, NEOFIRE Research Laboratory, 2019. SEM Analysis of unprepared Nickel mesh used for Mizuno type excess heat energy production LENR experiments

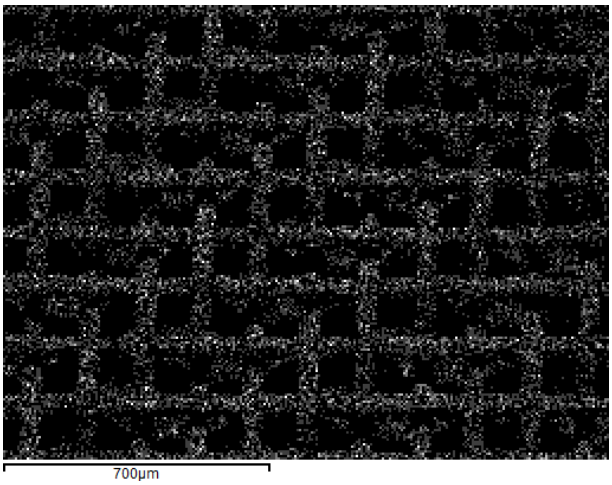

Fig. 7. Mesh: Sulphur is present in the wires.

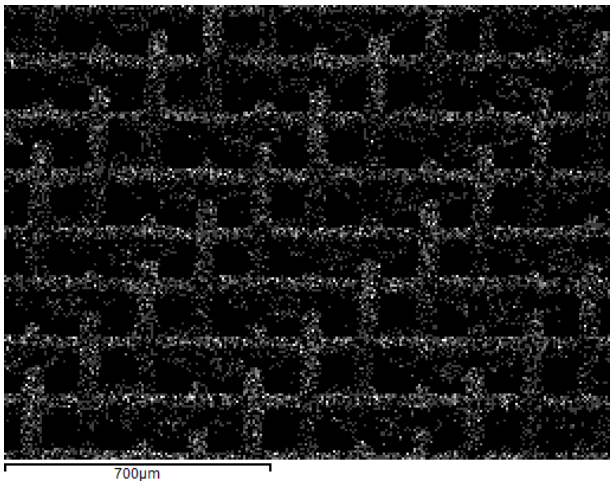

Fig. 8. Mesh: Aluminum is present in the wires.