SEM 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
16 September 2019

Abstract— **This is an analysis of surface texture, using Scanning Electron Microscopy (SEM), on a type of Nickel mesh material used in the area of excess heat energy production experiments (LENR, Low Energy Nuclear Reactions).**

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 surface texture of a Mizuno type LENR material using SEM instrument in its as-received state, before preparation steps and before being subjected to reactor experiments.

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 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.

Sample was provided to investigator courtesy of Jed Rothwell and Alan Goldwater during the International Conference on Condensed Matter Nuclear Science (ICCF-22) in Assisi, Italy 2019.

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.

C. Bulk material

Bulk material of mesh is specified as Nickel-200 (UNS N02200/W.Nr. 2.4060 & 2.4066) and is commercially pure (99.6%) wrought nickel.

Limiting chemical composition for Ni-200 can be found in Table I.

IV. Methods

SEM imaging to visualize structure and surface texture.

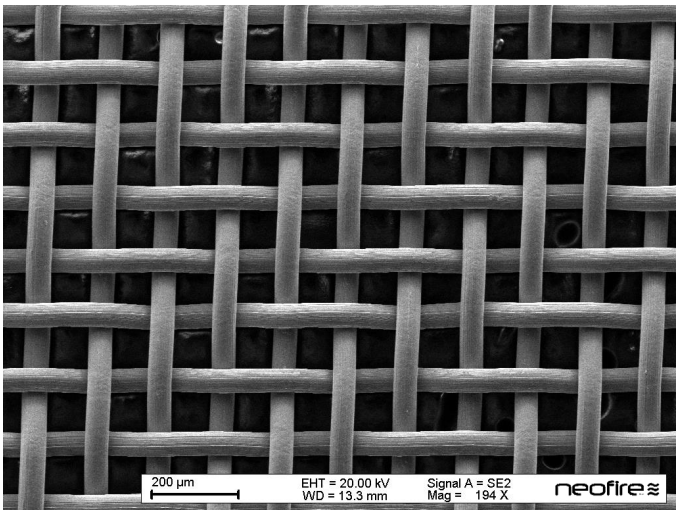

Fig. 1. Nickel-mesh sample material overview.

TABLE I
NICKEL-200, LIMITING CHEMICAL COMPOSITION, %

Nickel (plus cobalt)	99.0 min
Copper	0.25 max
Iron	0.40 max
Manganese	0.35 max
Carbon	0.15 max
Silicon	0.35 max
Sulfur	0.01 max

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 instrument.

VI. RESULTS

SEM imaging was perfomed on a Zeiss Ultra 55 FEG-SEM instrument.

SEM images show that material appears clean and consistent when imaging different parts of the mesh. Surface texture of the sample at higher magnification clearly shows striation patterns as can be seen in Figure 2.

VII. DISCUSSION

A. Surface Texture - Striations

Surface texture striation is extensive and striations appears to exist at different size/scales.

Striations could be either a result from the manufacture of the wire material, before the mesh was woven, or as a result from the process and machines handling the wire during mesh production.

B. Chemical composition

Industrial grade bulk Ni-200 material gives at hand there is a very large parameter space concerning bulk chemical composition and the composition are likely subject to variations between manufacturers of bulk material. Composition might also vary between batches.

Material properties such as surface texture and grain size are also likely subject to variations between manufacturers of wire and mesh. These properties might also vary between batches/machines for wire and mesh.

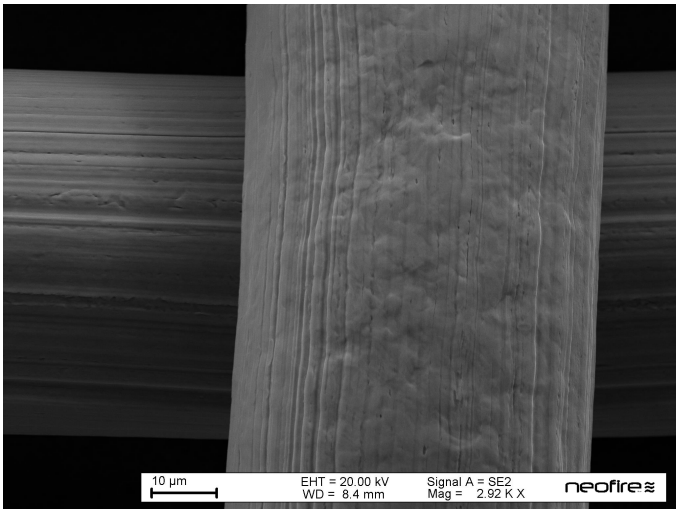

Fig. 2. Nickel-mesh material close up showing single wire. Striation can be clearly seen.

VIII. CONCLUSIONS

In SEM Nickel mesh material appears clean and consistent all over the mesh. An analysis of chemical element distribution on the surface using SEM/EDS technique would be of interest for further analysis in future investigations.

Surface texture of the sample clearly shows striation patterns. A deeper investigation of these striations at higher magnification would be of interest for further analysis in future investigations.

Specification of industrial grade bulk Ni-200 material gives at hand there is a very large parameter space concerning material properties e.g. bulk chemical composition, surface texture and grain size etc.

A comparative analysis of similar Nickel mesh materials from other manufacturers of bulk material/wire/mesh would be of great 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] Nickel-200, Special Metals, https://www.haraldpihl.com/globalassets/pdf/008_nickel-200–201.pdf