

Some Novel Analytical Techniques Applied to LENR Active Materials

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We will explore the results from the analyses of several low energy nuclear reactions (LENR)-active tubes run by Brillouin Energy (BEC) using several different techniques. The most novel analytical techniques are terahertz (THz) imaging and THz spectroscopy. This imaging technique gives insight into the lattice spacing of crystalline and micro-crystalline metals and ceramics complimentary to that from X-ray diffraction (XRD) measurements. Figure 1 shows one example of this imaging performed on the nickel outer coating on one of BEC's catalyst tubes showing a cube of material 100nm on each side [1]. XRD of powder removed from this sample showed the normal lattice spacing for pure Ni powder. However, THz imaging showed lattice dilation in the Ni coating. We will discuss the potential source of this dilation as well as its possible importance to LENR. We will also discuss the results of THz spectroscopy performed on materials from this and similar tubes [2].

In addition to novel techniques, more common analyses can give LENR researchers important insights into the properties of their active materials. Some of these other techniques of interest are:

X-ray fluorescence (XRF)

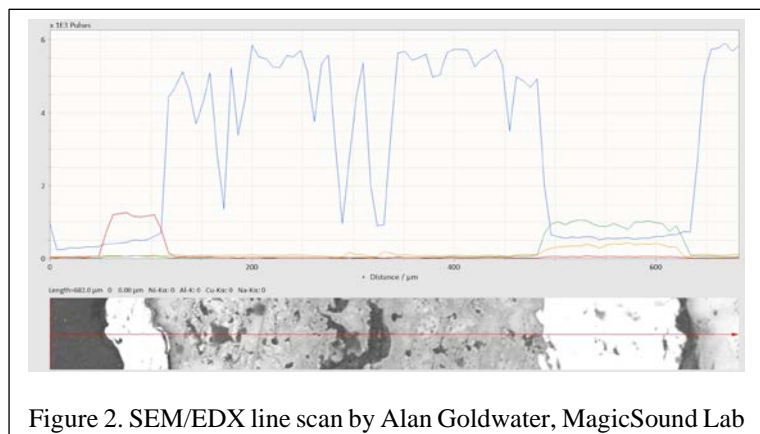
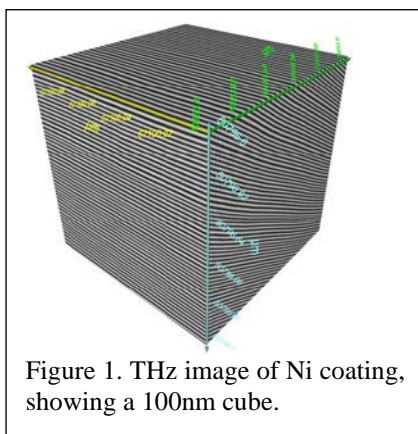
Optical microscopy

Scanning electron microscopy/energy dispersive X-rays (SEM/EDX)

Inductively coupled plasma – mass spectroscopy (ICP-MS)

Inductively coupled plasma – optical emission spectroscopy (ICP-OES)

We have used all of these techniques to identify the chemical and metallurgical properties of the coatings used in Brillouin's LENR studies. Sample preparation is usually very important before performing any of these analyses. We regularly cut, mount and polish samples for microscopy analyses. Figure 2 shows a very useful line scan performed on a coated sample using SEM/EDX to show a depth profile of different elements present in the coating. These and other results will be discussed with suggestions how different techniques can be applied to other LENR experiments.



[1] A. Rahman, F. Tanzella, A. K. Rahman, C. Page, R. Godes, "Lattice Dilation of Plasma Sprayed Nickel Film Quantified by High Resolution Terahertz Imaging", *Novel Research in Sciences*, vol. 2, no. 4, pp. 1-8, 2019.

[2] A. Rahman, D. Tomalia, "Terahertz Spectral Characterization of Plasma Spray-Deposited Nickel Film on an Alumina Cylinder", *Spectroscopy*, vol. 36, no. 4, pp. 20-27, 2021.