Synthesis and characterization of Nanostructured Coatings of Nickel Alloys

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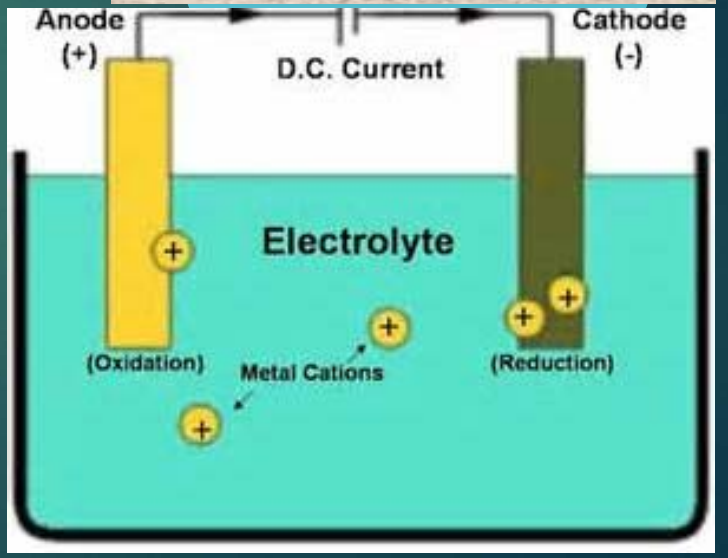
Introduction

- Nanocrystalline alloys; A metal with a grain size of less than 100 nm.
- Electroplating; When a substance is despotized on an electrode through the use of migration of electron through the electrolyte solution.
- Pulse Electroplating; Electrodeposition delivered in controlled bursts instead of a continuous current.
- Frequency; The rate at which something occurs or is repeated over a unit of time.
- Hardness; The resistivity of the materials against the plastic deformation upon the given load.



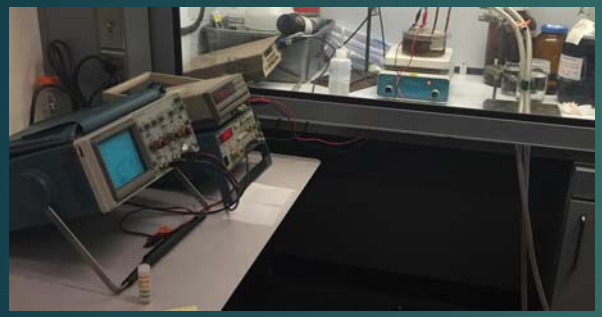
Objectives of project

- Make nanocrystalline Ni coatings on the mild steel.
- Investigate the effects of current density on the morphology of the coatings.
- Investigate the effects of current density on the hardness of the coatings.
- Investigate the effects of pulse frequency on the morphology of the coatings.
- Investigate the effect of pulse frequency on the hardness of the coatings.

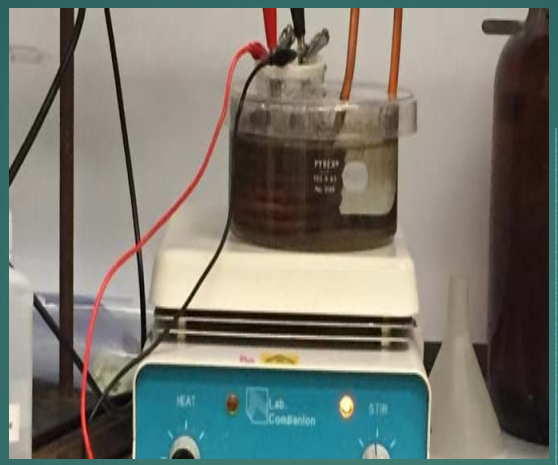
Preparing the Sample

- I start off by using sand paper of varies grains to shine the sample till it has a reflective surface. This gives my sample a surface that allows electrodeposition to be more useful in terms of quality and quantity. I than use black electrical tape to cover the steel strip save for an area of the steel that is 1cm in length and ½ cm in width. After this is complete, I then clean the prepared sample with ethanol and rinse it with DI water.

Experiment



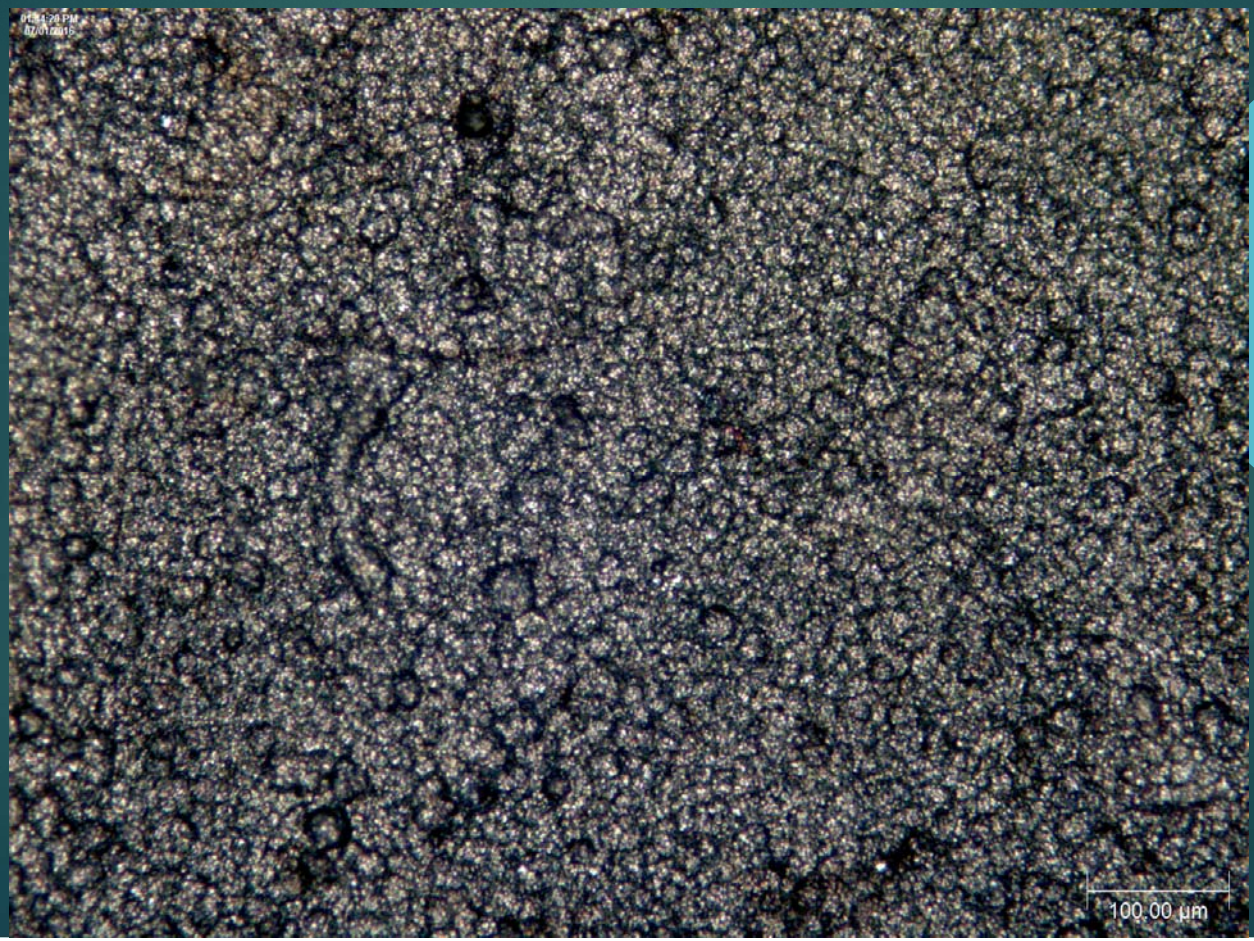
To start the experiment, I insert the sample into the Watts solution that is at 45 degrees Celsius and has a PH of 4.



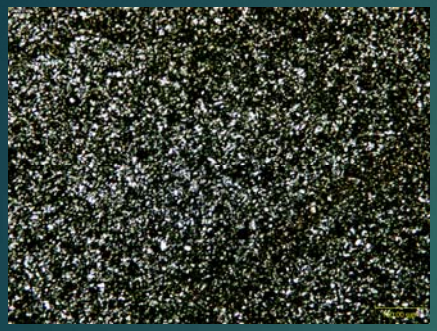
I than attach the sample and the nickel sample to the function generator.

Strip of nickel with sample

Data collection and imaging

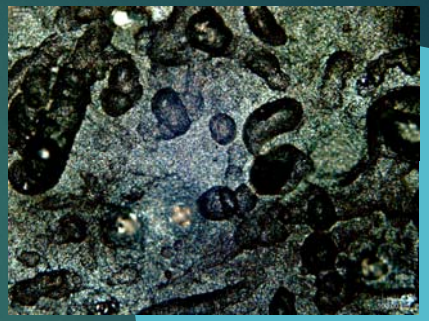


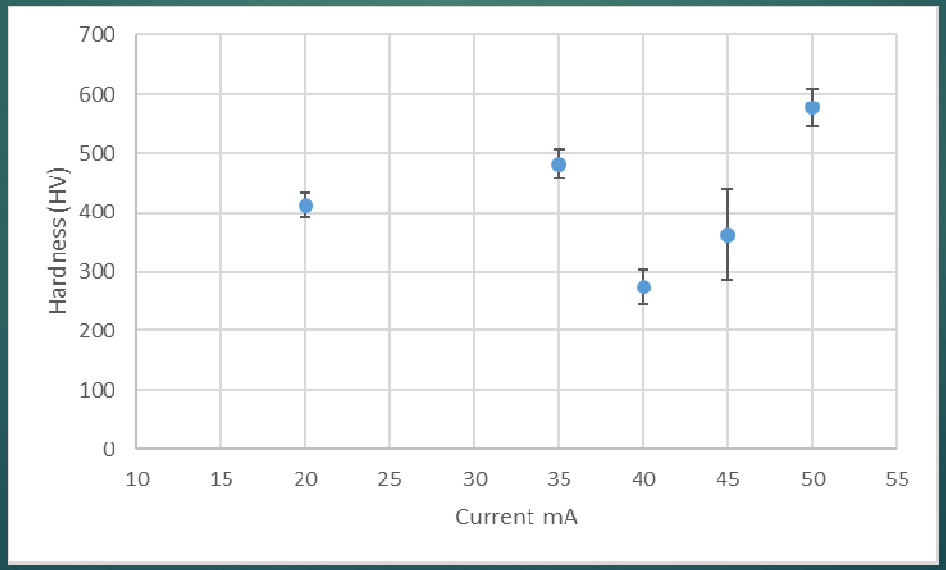
20mA 50Hz



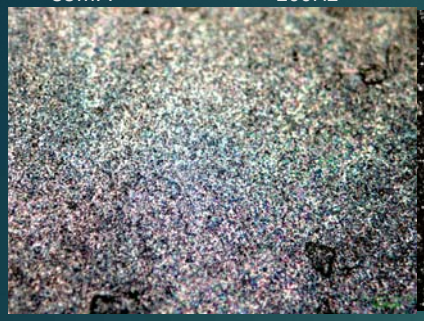
35mA 50Hz

50mA 50Hz



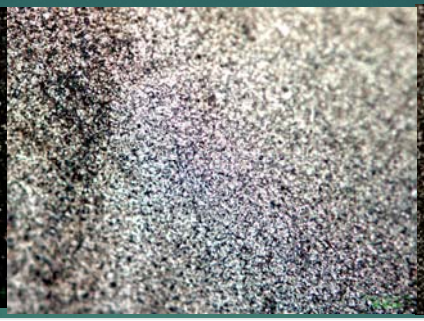


35mA 100HZ



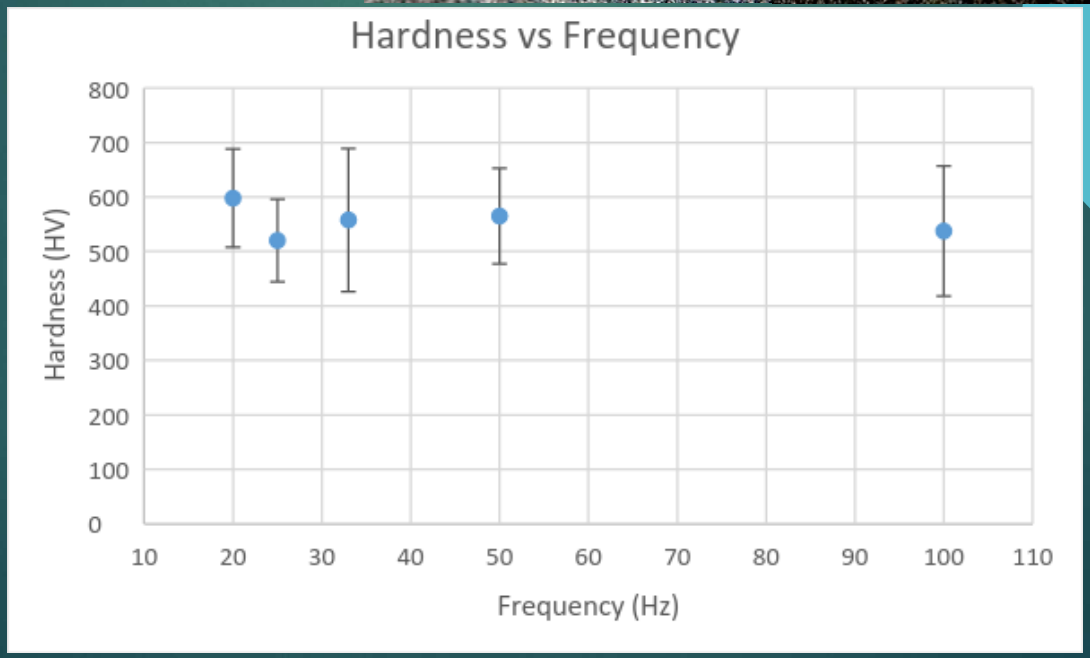
35mA 50Hz

35mA 33Hz



35mA 25Hz

35mA 20Hz



Conclusions

1. Using pulse electroplating, a nanostructured nickel coating was made over the surface of mild steel.
2. We studied the effects of current density on the morphology and hardness of the nanostructure Nickel coatings.
3. The results shows that up to 50 mA of current, we can achieve the coating with the hardness as high as 600 HV. However the current density of 50 mA or higher results in formation of hydrogen bubble, which changed the morphology of the surface. Hence, we chose to run the coating at 35 mA so that we assure that there is no Hydrogen formation.
4. Moreover, we studied the effects of frequency on the morphology and hardness of nanostructure Nickel coating.
5. The results show that the frequency interestingly does not affect the morphology of the coating. However it is evident from the hardness data that we are able to maintain the coating as hard as 600 HV at very low frequency. This suggests that coating at 35 mA and 20Hz are taken as the optimum condition for this experiment.

References

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Questions?