Electroplating of Nickel and Copper Layers on Nanoengineered Plastics
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Introduction
The motivation for this project is the development and proposed use of novel nanoengineered polymeric materials in many industrial and commercial applications. This necessitated the development of a robust metallic coating that can withstand aggressive environmental conditions.
This research explores the methods of electroplating nickel and copper to the substrate, including the effects of various duty cycles and cathode current density.

Nanoengineered Plastic
The nanoengineered polymer resin provided by SABIC is in the form of polymeric beads (~ 1 mm dia).
Using elevated temperature extrusion and compression molding, the beads were formed into sheets with a nominal resistance of 1000 ohms, then cut into circular wafers, as shown in Figure 1.

Experimental Procedure
In this study Copper and Nickel are electroplated using pulse plating technique, as shown in Figures 2 (a) and (b) respectively.
Copper Acid and Nickel Sulfamate are utilized as the bath electrolyte solutions, respectively.
Pulse deposition occurred at varying duty cycles including 25%, 50%, 75%, and 100% (DC deposition)
Cathodic current density is kept constant at 10 mA/cm² with an average film thickness of ~ 15 μm.

Results
Samples are examined using Scanning Electron Microscopy (SEM) with a Philips XL30 FEG SEM at 50X mag.
Figure 4 presents images used to compare the plated film surface morphology characteristics for copper and Nickel layers.

Conclusions
As shown in Figure 3, Copper exhibits a less porous deposit
Copper deposits were found to have prominent grain growth on the order of 500 to 2000 nm, whereas nickel displays a smooth, featureless topography.
For both copper and nickel: Young’s Modulus tends to increase with an increase in duty cycle, Figures 5 and 6, respectively
On average Copper films results in a 60% higher Young’s Modulus then Nickel
On average Nickel films results in a 115% higher Hardness then Copper
Independent testing determined a nominal adhesion force of 25 N for these metallic films.

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