



**EFFECT OF MILLING TIME ON THE MICROSTRUCTURE  
OF NIFE ALLOY**

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## ABSTRACT

Nickel-Iron (NiFe) base alloys (permalloy) are commonly used as soft magnetic materials, exhibiting high permeability, low coercivity, low magnetostriction and high-saturation magnetization. This material is often used in electronic industry. The continuous research of this material can improve its characteristics beside find new functionality so that it can give benefits to people. The main objective of this research is to investigate the effect of milling time on the microstructure and properties of NiFe. The experiment was conducted by using pure Nickel (Ni) and Iron (Fe) powders 99.9% purity. The powder mixtures were milled with various milling time of 2 hours, 4 hours and 6 hours in a zirconium oxide jar and ball-to-powder ration (BPR) of 3:1 was used. The milled powder were compacted and annealed in the hot furnace with 600°C annealing temperature and holding time for 1 hour. X-Ray Diffraction (XRD) technique and Energy Dispersive X-Ray (EDX) were used to study the composition of the samples before and after annealing. Electromagnetic testing and hardness testing also was conducted to examine the electroconductivity and hardness of the samples respectively. Besides, microscopic examination was carried out using optical microscope and Scanning Electron Microscopy (SEM) analysis to observe particle morphology of NiFe alloys. The result showed as the milling time increased, the particles and crystallite size of material were decreased less than about 18nm and the fine microstructure of NiFe was achieved. XRD analysis shows the NiFe alloys consisting of Ni, NiFe and Fe<sub>3</sub>O<sub>4</sub>. The highest value of hardness and electrical resistivity obtained are 78.7 HRA and 11.45 Ohm.m.

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