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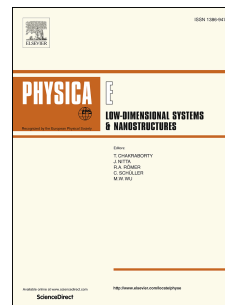
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**Rheological behavior characteristics of ZrO<sub>2</sub>-MWCNT/10w40 hybrid Nano-lubricant affected by temperature, concentration, and shear rate: an experimental study and a neural network simulating**

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**Abstract**

In this project, the ZrO<sub>2</sub>-MWCNT (70%-30%)/10w40 hybrid Nano-lubricant was experimentally evaluated in terms of rheological changes. ZrO<sub>2</sub> (40 nm) and MWCNTs nanoparticles with an inner diameter of 3-5 nm were used to prepare the Nano-lubricant. Particles were weighted for solid volume fractions of 0.05%, 0.1%, 0.25%, 0.5%, 0.75%, and 1% and the Nano-lubricant was prepared. Then, the viscosity of Nano-lubricants was measured at different shear rates between 5 to 55 °C. The results showed that the pure oil was non-Newtonian and the Nano-lubricant was pseudoplastic. Calculation and checking the power law and consistency coefficients showed that the increase in temperature intensifies the non-Newtonian behavior. Based on the results, at temperature of 55 °C and a volume fraction of 1% condition, maximum amount of dynamic viscosity enhancement(DVE) was investigated. Based on viscosity experimental data, a new correlation was proposed at different temperatures and the solid volume fraction, and the sensitivity of Nano-lubricant was measured. An Artificial Neural Network (ANN) with two hidden layers and six neurons was designed to predict the viscosity. R<sup>2</sup>, MSE, and AARD values were obtained as much as 0.9905, 7.0631e-05, and 0.0051 ANN,

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