Abstract

Aly I Shehata

Numerical and experimental investigation of flow structure and behavior of nanofluids flow impingement on horizontal flat plate

Numerical and experimental studies have been conducted to investigate flow structure and heat transfer of nanofluid jet normally impinging on a flat plate. Al2O3–water is used as working fluid. The governing equations are numerically solved using finite volume approach together with SIMPLER algorithm. A wide spectrum of experimental and numerical simulations has been done. The results covered wide ranges of Reynolds number, Re, from 3000 to 32,000, nanofluid volume fraction, ?, from 0 to 10%. The dimensionless distance from jet nozzle to the horizontal plate was kept constant at 3. An experimental apparatus was constructed to measure the film thickness distribution, wall temperature and temperature of flowing fluid. The effects of Re and ? are investigated on the film thickness distribution, isothermal contours, and both local and average Nusselt numbers. A good agreement was found between the numerical and experimental results as well as the previous cited results. The results showed that the increasing of nanoparticle percent increases the convective heat transfer coefficient compared with the pure water. At ? = 10.0% and Re = 24,000 the heat transfer coefficient increases by 62% compared with the pure water. The effect of nanofluid type (Al2O3–TiO2–CuO) is studied numerically. It has been observed that the CuO nanofluid increases the heat transfer by 8.9% and 12% compared to aluminum and titanium nanofluid respectively.