Volume 11, Issue 5, May – 2026 International Journal of Innovative Science and Research Technology
ISSN No:-2456-2165 https://doi.org/10.38124/ijisrt/26may1634

Cooling Effects of Certain Nanofluids on Polyethylene Stretching Sheets

Adeboje, T. B.[1]; Falana, A.[2]

[1]Department of Mechanical Engineering, Adeseun Ogundoyin Polytechnic, Eruwa, Ibadan,
[2]Department of Mechanical Engineering, University of Ibadan, Ibadan

Publication Date: 2026/06/09

Abstract: In this study, the significance of cooling effects of aluminum oxide, zinc oxide and copper oxide nanofluids were examined over conventional fluid past polyethylene stretching sheet. The cooling effects of the nanofluid on the polyethylene stretching sheets with the source Temperature of 212℃ at the velocity of 1.42 m/s were recorded. The molten temperature of the polyethylene at the extruder as it was passing through the nanofluid was taken for 50 minutes at 10 minutes' interval. The temperature were recorded for aluminum oxide, zinc oxide and copper oxide nanofluids as 57.5, 58.2, 60.3 and 64. 5^0C, while the thermo physical properties (Density, Viscosity, Concentration, Specific Heat Capacity and Thermal Conductivity) and water were: 1.01kg/m3, 0.601poise, 1.93x10 −4mol/dm3, 1.009 kg/m^3, 0.806 poise, 2.27 x10^{-4}mol/dm^3 and 0.60 wm−1K−1 and 1kg m3 ⁄, 0.95poise, 0.00 mol/dm3 and 0.6 wm−1K−1, respectively. The results showed the aluminum, Zinc and Copper Oxide nanofluids; and water heat transfer effects on the cooling of hot polyethylene materials. The aluminum, zinc and copper oxides in nanoparticle-based fluids improved the cooling properties of stretching sheets over water. `

Keywords: *Polyethylene, Cooling Effect, Nanofluids, Stretching Sheet, Conventional Fluid.*

How to Cite: Adeboje, T. B.; Falana, A. (2026) Cooling Effects of Certain Nanofluids on Polyethylene Stretching Sheets. *International Journal of Innovative Science and Research Technology*, 11(5), 3754-3758.
https://doi.org/10.38124/ijisrt/26may1634

I. INTRODUCTION

Many scientists and engineers are interested in the development of nanofluids as a result of technological innovations, research, and their applications in many industrial process. Numerous papers and books have been written in recent years that detail the fields and manufacturing industries that benefit from the assertions and use. For example, the industries involved include plastic sheet extrusion, glass production and aerodynamics. In the evolutions of heat and mass transfer of nanofluids, many researchers have in details, developed a lot industrial applications to address convective innovation. Awua *et al* (2024) showcased nanoparticles shape and that the average particle shapes about 26 nm. Chaya and Joy (2025) synthesized Ag and Au-h-BN(NP) substrate for adequate use. The plasmatic architecture created gap serving as hotspots for enhanced SERS signals. The substrate's surface morphology, purity, and chemical bonding were thoroughly analyzed. Its Surface-Enhanced Raman Spectroscopy (SERS) efficacy was evaluated using R6G, demonstrating notable spectral reproducibility and effectiveness. Xu and Pop (2014) researched radiation impacts for two-layered stagnation-direct progression of gooey nanofluid toward solar powered energy. Bondareva et al. (2015) mentioned that Magneto-hydrodynamics (MHD) has to do with the study of the movement of electrolytes in the fluid flow. The cooling processes of CuO-NFs, and $Al_2 O_3$–NFs were predicted and quantified. Copper oxide and aluminum oxide base fluids revealed enhanced cooling qualities over polyethylene materials with fine surface texture when compared with water. Poorly cooled stretching sheets are characterized by defects which affect surface finish and qualities of the products. Water is a conventional coolant for Stretching Sheets, but causes defects and deteriorates its surface-texture-aesthetic characteristics. Nanofluids are effective coolants in automobile radiators. Following the development of nanofluids and its implication on boundary layer, the theoretical simulation harnessed many theories and thermophysical properties in addressing boundary layer problem. The fluid's flow is influenced by Brownian motion, thermophoresis, Prandtl number, Eckert number, and Lewis parameters. According to the authors, thermal conductivity increases as the volume fraction increases when dynamic viscosity is calculated using Brinkman's equation. The recorded temperature ranged from 38.83 to 76.70 degrees Fahrenheit, representing the lowest and highest cooling temperatures. Particles of aluminum oxide improve nanofluids' ability to transfer heat. (Bodius and Abu, 2022). Peyghamberzadeh *et al*. (2011) discovered the improved exhibitions of nanofluids' specific heat capacity, improved cooling as a result co-efficient friction. Additionally, ZnONFs and CuONFs showed improved thermal conductivity, efficient temperature respons and outperformed water. The result showed significant improvement for efficient heat transfer of ZnO-NFS with 15.9 while compare

ISSN No:-2456-2165 https://doi.org/10.38124/ijisrt/26may1634

to 19.5°C of water base fluid with a heat transfer coefficient and average heat enhancement of 20%. Particles of zinc oxide had good thermal conductivity, (Xuan and Li (2000). Xu and Pop (2014) argued the significance of buoyancy in nanofluids, through Prandtl number and boundary layer dynamics.

Buoyance affected magneto-hydrodynamic of convective heat transfer, more noticeable buoyancy effect. Abu-Nada *et al.* (2010) in the International Journal of Thermal Sciences, described the effect of varying nanofluid properties affect free convection heat transfer within a confinement. Such that it revealed the magnetic, suction-injection, Brownian motion, Thermophoresis, Prandtl, Eckert, and Lewis numbers had impacts on the flow of the fluids. Bawoke and Birhanu (2023) examined nanoparticles and classified them based on qualities production and applications.

Furthermore, non-similar regions close to the extrusion slit had significantly higher reduced Nusselt and Sherwood numbers than self-similar regions. Many have investigated the variables that affect the characteristics of nanofluids.

➢ *Problem Statement*

In this paper it is noted that the cooling characteristics of conventional fluids (water and air), is susceptible to defects. The classification of cooling effects of nanofluids provides cooling properties' predictions and its quantifications. Aluminum oxide, Zinc Oxide and Copper Oxide fluids were explored for their cooling characteristic over conventional fluid (Water and air) past Polyethylene Stretching Sheet.

II. METHODS AND METHODOLOGY

The industrial plastic extrusion was employed to examine the cooling effects under the following parameter: The plastic extrusion has five important chambers, including a hopper for collecting Pellet plastics as raw materials to be melted and ten band heaters with 700 KW barrels, Stretching sheet was of 10 mm, the source Temperature (ST) of 212℃ at the velocity of 1.42m/s. The molten plastics formed strands through the dies and passing through the cooling medium for 50 minutes at 10 minutes' interval. Three thermometers attached were located in the bath for readings at 500mm apart.

III. RESULT AND DISCUSSION

The cooling effects Aluminum oxide, Zinc Oxide Copper Oxide fluids past the polyethylene stretching sheet demonstrated the importance of temperature in enhancing the cooling characteristics of the stretching sheets.

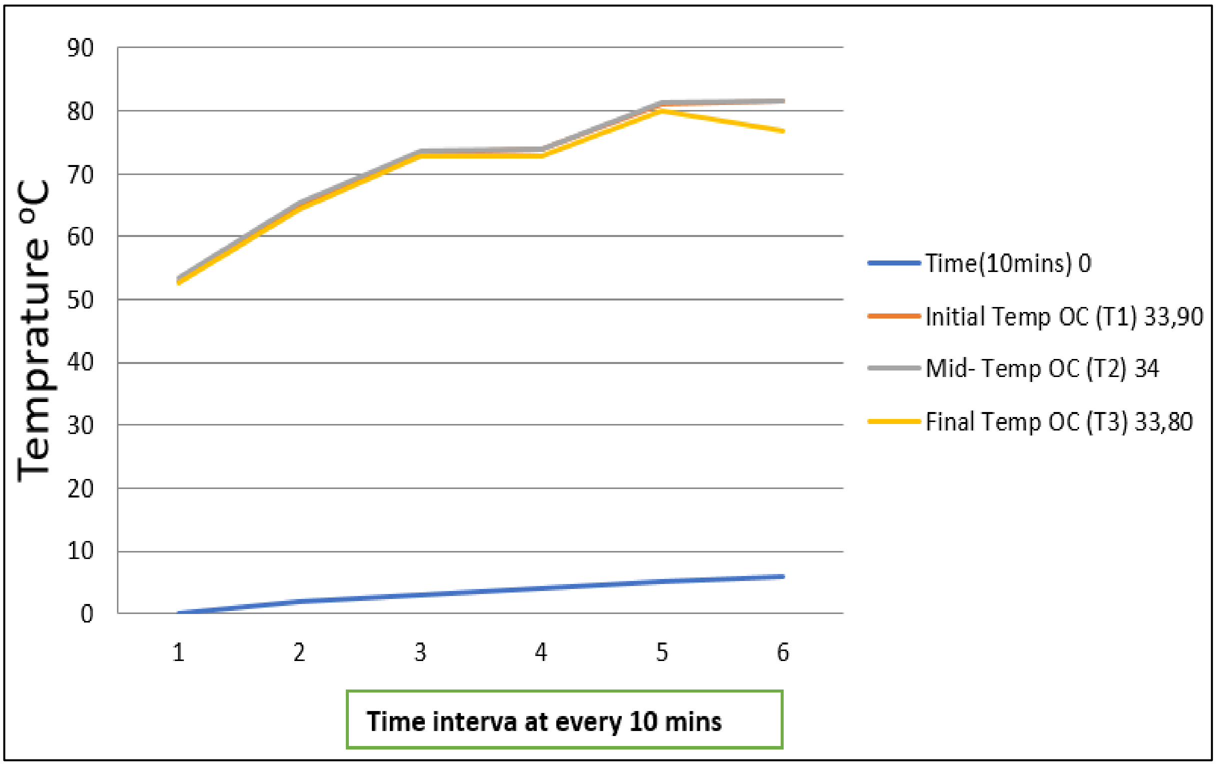

Fig 1 Experimental Control Water Base fluid

Figure 1 depicts the cooling effects of conventional fluid wherein there were defects peculiar to water over Polyethylene Stretching Sheets.

ISSN No:-2456-2165 https://doi.org/10.38124/ijisrt/26may1634

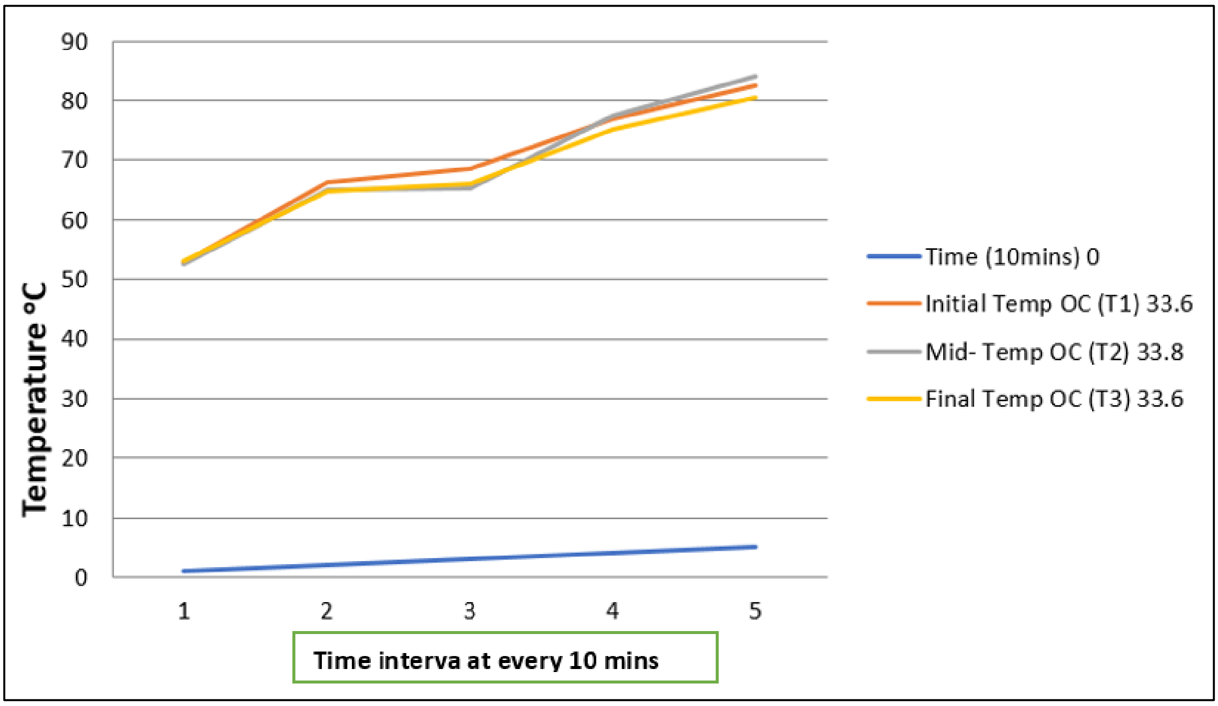

Fig 2 Cooling Effects Copper Oxide Namofluids

Figure 2 shows the cooling effects of Copper Oxide nanofluid past the stretching sheets with a significant cooling stability between 10-30minutes for evenly heat distribution. It of course enhanced the quality of materials when compared to water cooling media. The significant of enhanced layers showed the impacts of nanoOxide in the cooling fluids. The stretching sheet responded to cooling as time and temperature increases for efficient heat distribution on the quality of materials being cooled.

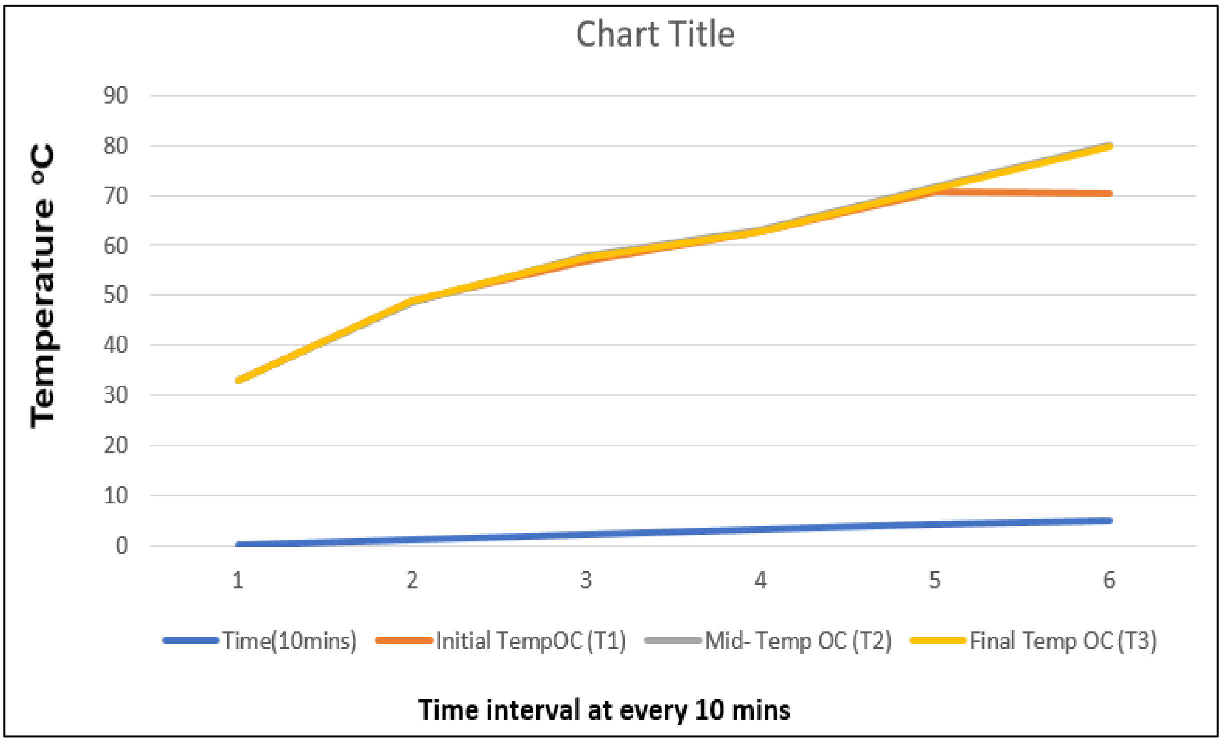

Fig 3 Cooling Effects Zinc Oxide Namofluids

Figure 3 implies the effective cooling properties by reducing temperature for cooling distribution without rashly cooling the sheets. The polyethylene sheet encountered a steady temperature. At such, the cooling properties looked promising to be adequate to overcome defects on the surface of the materials or evenly distributed cooling effects.

ISSN No:-2456-2165 https://doi.org/10.38124/ijisrt/26may1634

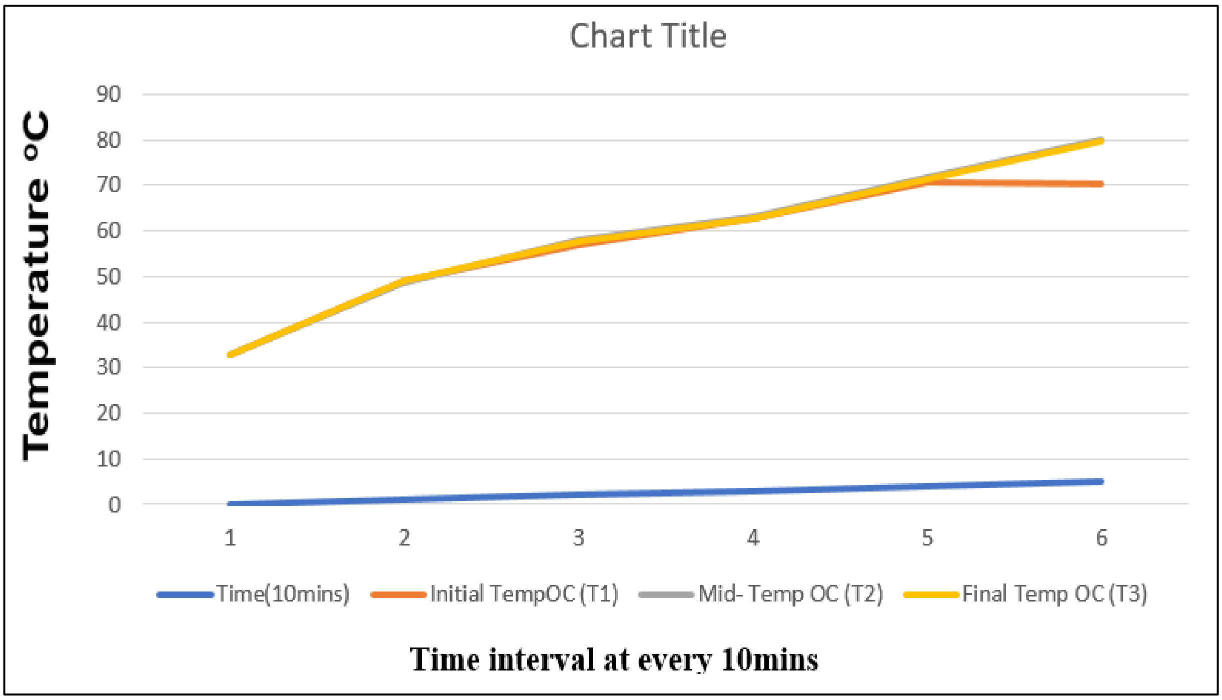

Fig 4 Cooling Effects of Aluminum Oxide ($Al2O_3$ NPs) Namofluid

Figure 4 showed the cooling medium enhanced by aluminum oxide. The graphs presented medium to have more cooling enhancement when compared to Zinc oxide. There was a better drag in the cooling process and its heat transfer stability at 32°C - 70°C temperature difference.

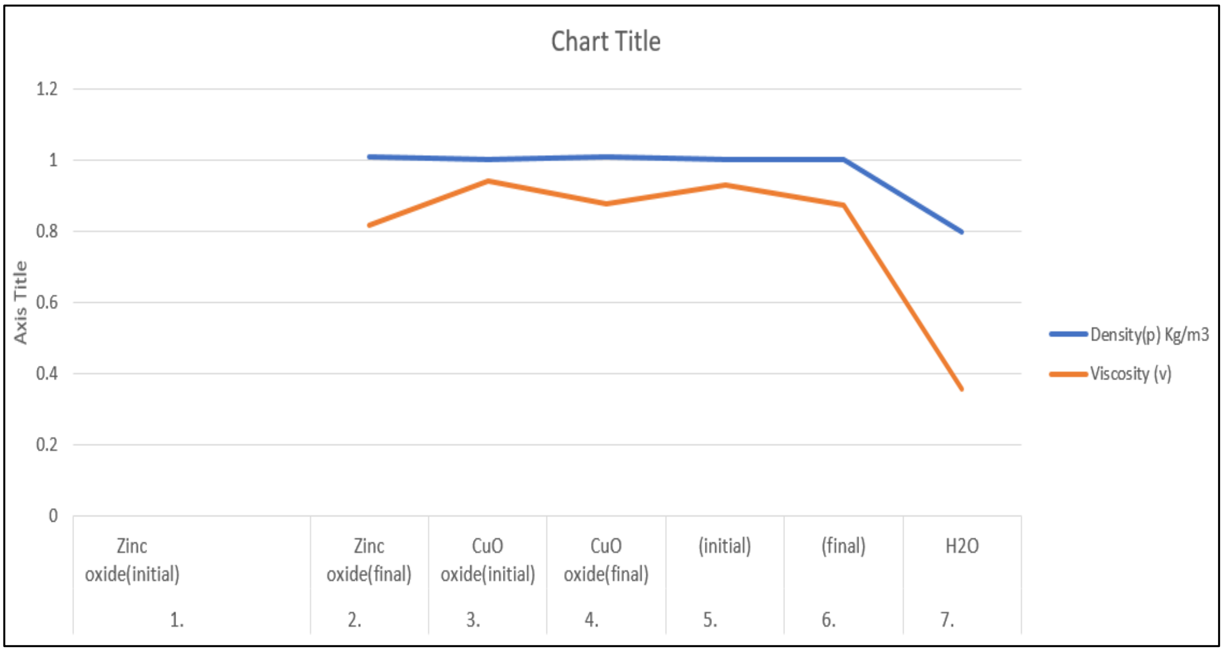

Fig 5 Thermal Physical Properties of Nanoparticles –Base Fluids (Density and Viscosity)

Figure 5 showed the development of the density and viscosity on the stretching sheet in that both reflected effects of temperature on the decrease. When compared to water, the density and viscosity of aluminum, Zinc and Copper Oxides in the cooling process showed a significant effect on the materials. The decrease on the substance showed how much the temperature was lowered of the substance. By implication, it indicated there is appropriate cooling effects on the Stretching Sheets (SS).

IV. CONCLUSION

The nanofluids of aluminum, Zinc and Copper Oxides display an exceptional ability in addressing cooling characteristics in that it generated drags sufficiently adequate for cooling. Though, each fluid oxide displays a relevantly different characteristics in cooling process.

ISSN No:-2456-2165 https://doi.org/10.38124/ijisrt/26may1634

REFERENCES

[1]. Xuan, Y. and Li, Q. 2000 Heat Transfer Enhancement of Nanofluids. International Journal of Heat and Fluid Flow, 21, 58-64.http://dx.doi.org/10.1016/S0142-727X (99)00067-3.

[2]. Peyghambarzadeh, S. M., Hashemabadi, S. H., Jamnani, M. S. and Hoseini, S. M.. 2011. Improving the Cooling Performance of Automobile Radiator with Al2O3/water Nanofluid. Journal of Appl Therm Eng 31:1``111833–1838

[3]. Abu I. A., Bodius S., 2020. A Review on Nanofluid: Preparation, Stability, Springer Nature Switzerland AG 202 thermophysical properties, heat transfer characteristics and application.SN Applied Science Vol. 2, (1636)

[4]. Xu, H., Pop, I., 2014. Fully Developed Mixed Convection Flow in a Horizontal Channel Filled by a Nanofluid Containing Both Nanoparticles and Gyrotactic Microorganisms, European Journal of Mechanics B/Fluids, 46,pp. 37-45.

[5]. Awua, J. T,. Ibrahim, J. S, Krishna, S. J., Edeoja, A. O., A. Kuhe A. K.,. Sharifpu, M., S. Murshed, S. M., 2024. Synthesis, characterisation, physicochemical, and electricalproperties of natural (bio) nanofluids, Environ Prog Sustainable Energy.2024;43:e14397.wileyonlinelibrary.com/journal/ephttps://doi.org/10.1002/ep.14397DOI:10.1002/ep.14

[6]. Bondareva, N. S., Sheremet, M. A. and Pop, I., 2015. Magnetic Field Effect on the UnsteadyNatural Convection in a Right-Angle Trapezoidal Cavity Filled with a Nanofluid. InternationalJournal of Numerical Methods for Heat & Fluid Flow.25:1924-1946.

[7]. Chamkha, A. J., Ismael, M.A., 2014. Conjugate Heat Transfer in a Porous Cavity Filled with Nanofluidsand Heated by a Triangular Thick Wall, International Journal of Thermal Sciences, 67, pp. 135-15

[8]. Chayan K. M. and Joydeep., C. 2025. Fabrication of Ag@AuNPs embedded h-BN Langmuir-Blodgett film as SERS active platform for trace detection of fungicide in solution and in grape skin, Department of Physics, Volume 8, page 100153 Jadavpur University, 188, Raja S.C. Mallick Rd, Kolkata 700032, India.

[9]. Bawoke M. and Birhanu A, 2023. Nanomaterials: An overview of synthesis, classification, characterisation, and applications. Nano Select 2023; 4:486–501.DOI: 10.1002/nano.202300038