Numerical Modeling on Heat Dissipation from Electronics through Water-Titanium Carbide Nanofluid

N. K. Kund

Abstract*: *In enduring examination, CFD codes stand established and executed with water-TiC nanofluid to envision the thermal alarms of ICs. The convective governing equalities of mass, force and drive are computed for envisaging the thermal issues of ICs. The time pace selected throughout the intact computation is 0.0001 s. The soundings affect CFD forecasts of temperature curve, temperature arena plus fluid-solid boundary temperature of IC. The fluid-solid boundary temperature of IC is viewed as 310 K. This stands far less than the chancy limit of 356 K temperature wished for the objective of outwitting thermal cataclysm of IC. Tritely, the temperature of water-TiC nanofluid stands peak contiguous to the IC locality. Further, the temperature of water-TiC nanofluid gently drops with improvement in aloofness from IC. Afterwards, this becomes surrounding temperature in the distant arena precinct. The analogous tinted temperature curve stands accessible. Besides, the harmonizing graph of temperature against distance from IC stands revealed. Tritely, the evolution of CFD construal stay beside the capabilities of stances.

Index Terms*: *IC, CFD Codes, Heat Dissipation, Water-TiC Nanofluid.

I. INTRODUCTION

An indication of thermal dissipations in automated devices from interconnects to server farm stay confirmed in figure 1. Electronics heat dissipation caught numerous routines for illustration.The standard heat dissipation arrayed heretofore for instance, atmospheric convection is inappropriate for extreme thermal flux treatments. Still, in the preceding years the strange way of heat dissipation has compelled the researchers' ubiquitously within the sphere for the humdrum of nanofluid heat control.

Additionally, the nanofluid thermal dissipation is unequivocally spirited as ambient heat dissipation is poor to deliver the drive. Numerical and experimental reviews on heat spreading over rectangular domain are existent in texts [1-7]. Computational and experimental work with solidification also stand offered [8-20].

Nonetheless of the facts that the nanofluid cooling equivocates the issues about the extreme heat battle as to ambient heat dissipation and hence, the treatment of nanofluid remains the significant drive of the extant exploration. Here, the heat dissipations of electronics through water-TiC nanofluid stay reconnoitered numerically.

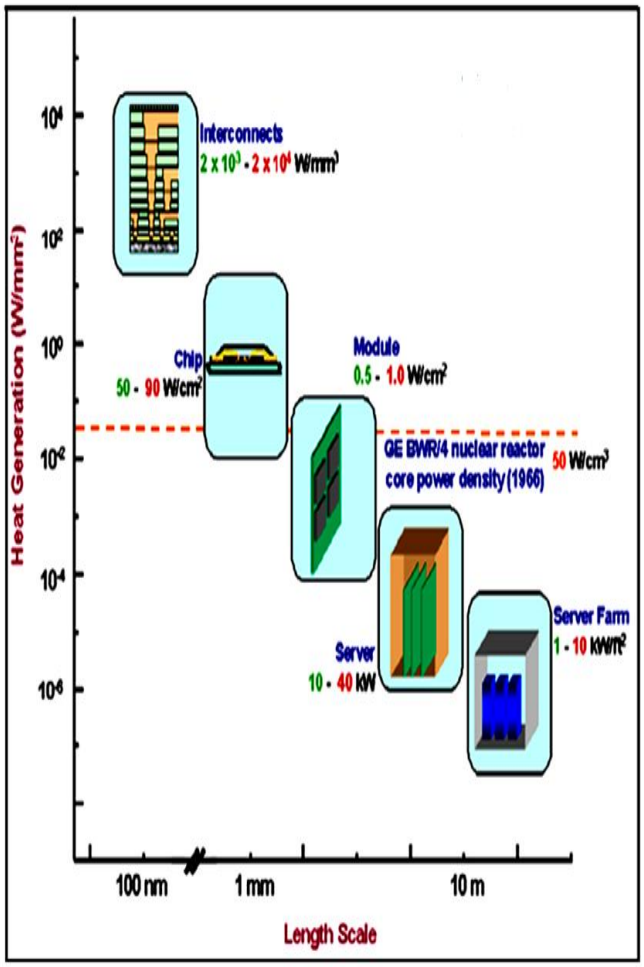

Figure 1. Uninterrupted growth of electronic devices

II. DESCRIPTION OF PHYSICAL CONCERN

Figure 2 divulges the physical theme course problem covering a heat generation from integrated circuit (IC) segment indicating the foot edge. Rest three edges are signposted through ambient situations. Here, the thermal dissipations from electronics is completed over water-TiC nanofluid. Further, the thermo-physical plus model data of TiC nanoparticles reflected in the existent analysis plus the ambient situation involved in the current course

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computations, stand informed excessively within Table 1.

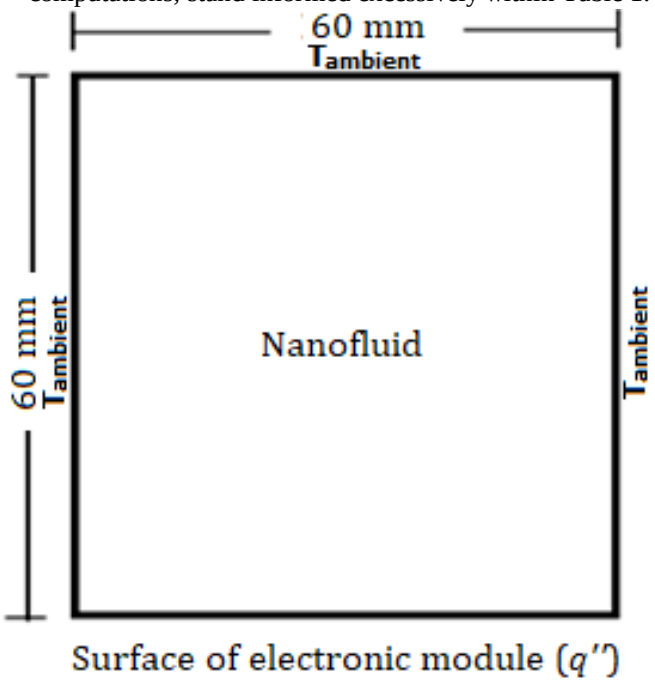

Figure 2. Pictorial depiction of IC computational arena

Table 1. Thermophysical and model data.

Nanoparticle Properties	**TiC**
Density, ρ (Kg/m^3)	4932
Specific heat, C_P (J/kg.K)	712
Thermal conductivity, k (W/m.K)	331
Model Data	**Values**
Cavity size	60 mm
IC size	60 mm
Ambient temperature	300 K
IC heat transfer rate/area	70 W/cm^2

III. COMPUTATIONAL METHODOLOGY

As declared above, the figure 2 reveals the CFD worktable aimed at computing the physical topic course. To facilitate the CFD forecasts the binding stages such as constructing geometry and purview, meshing and initialization are followed to run the simulation. Here, the prevailing equalities (as termed below through equalities 1-4) of mass, force and drive beside the edge states are chosen. Linearized equalities are computed through the CFD codes. After the development of computations, CFD codes form the shapes and curls through that numerous graphs stand strained to amalgam the CFD forecasts through the prognoses. With the later dispensation the forecasts are scrupulously explored aimed at receiving abundant acumens.

Continuity: $$\frac{\partial u}{\partial x}+\frac{\partial v}{\partial y}=0 \quad (1)$$

X-momentum:

$$\rho\left(\frac{\partial u}{\partial t}+u\frac{\partial u}{\partial x}+v\frac{\partial v}{\partial y}\right)=-\frac{\partial P}{\partial x}+\mu\left(\frac{\partial^2 u}{\partial x^2}+\frac{\partial^2 u}{\partial y^2}\right) \quad (2)$$

Y-momentum:

$$\rho\left(\frac{\partial v}{\partial t}+u\frac{\partial v}{\partial x}+v\frac{\partial v}{\partial y}\right)=-\frac{\partial P}{\partial y}+\mu\left(\frac{\partial^2 v}{\partial x^2}+\frac{\partial^2 v}{\partial y^2}\right)+\rho g\beta\Delta T \quad (3)$$

Energy:

$$\left(\frac{\partial T}{\partial t}+u\frac{\partial T}{\partial x}+v\frac{\partial T}{\partial y}\right)=\alpha\left(\frac{\partial^2 T}{\partial x^2}+\frac{\partial^2 T}{\partial y^2}\right) \quad (4)$$

In the ongoing examination, CFD codes are established and executed with water-TiC nanofluid to visualize the thermal concerns of ICs. The convective governing equalities of mass, force and drive are computed for envisaging the thermal issues of ICs. The time hop nominated in the integral iteration is 0.0001 s.

IV. RESULT AND DISCUSSIONS

CFD codes stand established and executed with water-TiC nanofluid. It envisages the impacts on heat dissipation of ICs. The soundings affect CFD forecasts of temperature curve, temperature arena plus fluid-solid boundary temperature of IC.

Effect of Water-TiC Nanofluid on IC Heat Dissipation

To expedite the scouting for the stimulus of water-TiC nanofluid on IC cooling, the contemporaneous corporeal archetype stands computed numerically bearing in mind both thermophysical and model data regarding the standing positions.

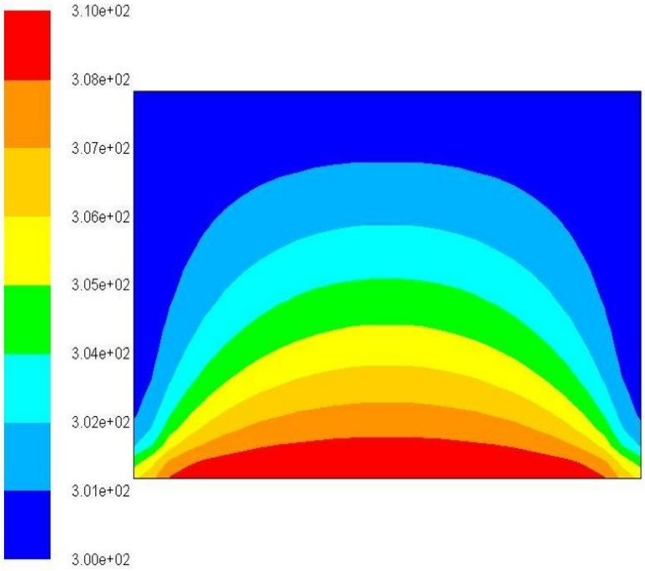

Figure 3. Temperature arena with water-TiC nanofluid

Figure 3 discloses the CFD prognosis of temperature arena besides the tinted measuring scale screening the temperature values over K. It stands viewed at the documented archetype statuses bearing in mind the water-TiC nanofluid for IC heat dissipation. The fluid-solid boundary temperature of IC is viewed as 310 K. This stands

far less than the chancy limit of 356 K temperature wished for the objective of outwitting thermal cataclysm of IC. Tritely, the temperature of water-TiC nanofluid stands peak contiguous to the IC locality. Further, the temperature of water-TiC nanofluid gently drops with improvement in aloofness from IC. Afterwards, this becomes surrounding temperature in the aloof arena precinct.

The equivalent tinted temperature curve stands accessible in figure 4 on top. Besides, the harmonizing graph of temperature against distance from IC stands revealed in figure 5. Tritely, the development of CFD elucidations stand along the structures of prospects.

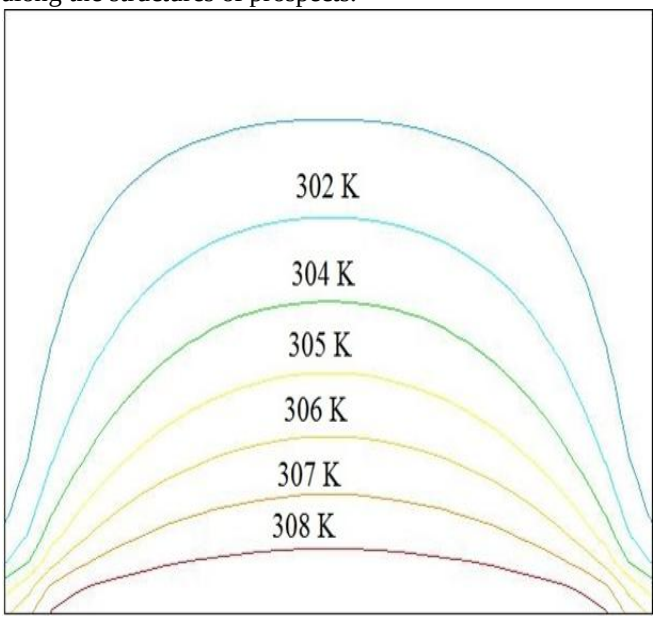

Figure 4. Temperature curve with water-TiC nanofluid

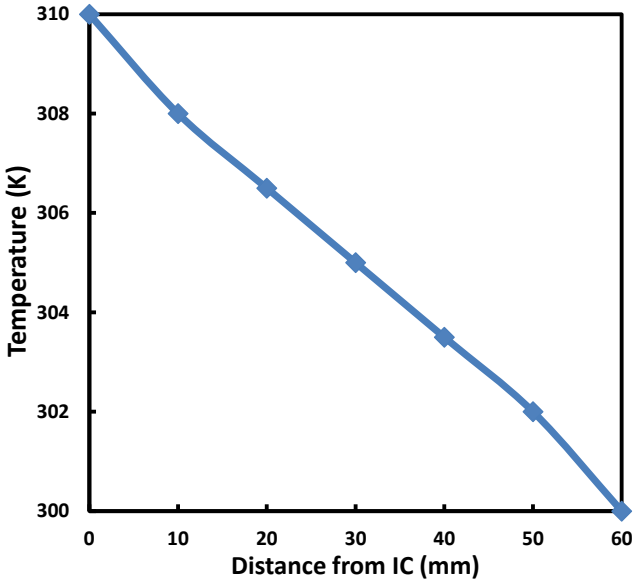

Figure 5. Temperature vs. distance from IC

V. CONCLUSION

In the contemporary examination, CFD programmes stay developed and executed with water-TiC nanofluid to visualize the thermal concerns of ICs. The convective governing equalities of mass, force and drive are computed for envisaging the thermal issues of ICs. The time pace selected throughout the intact computation is 0.0001 s. The soundings affect CFD forecasts of temperature curve, temperature arena plus fluid-solid boundary temperature of IC. The fluid-solid boundary temperature of IC is viewed as 310 K. This stands far less than the chancy limit of 356 K temperature wished for the objective of outwitting thermal cataclysm of IC. Tritely, the temperature of water-TiC nanofluid stands peak contiguous to the IC locality. Further, the temperature of water-TiC nanofluid gently drops with improvement in aloofness from IC. Afterwards, this becomes surrounding temperature in the distant arena precinct. The analogous tinted temperature curve stands accessible. Besides, the harmonizing graph of temperature against distance from IC stands revealed. Tritely, the establishment of CFD explications stay alongside the upbringings of potentials.

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Dr. N. K. Kund has obtained both M.Tech. & Ph.D. in Mechanical Engineering from Indian Institute of Science Bangalore. He has also obtained B.Tech.(Hons) in Mechanical Engineering from IGIT Sarang, Utkal University Bhubaneswar. He has published several research papers in international journals and also guided many research scholars, besides, wide teaching and research experience. He is presently working as Associate Professor in the Department of Production Engineering, VSSUT Burla (A Government Technical University).