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Laminar mixed convection heat transfer of SiC-EG nanofluids in a triangular enclosure with a rotating inner cylinder: simulations based on the measured thermal conductivity and viscosity

Keywords: SiC-EG nanofluids, Mixed convection, Triangular enclosure, Rotating cylinder, Rayleigh number

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Main goal

- To study the influence of circular coaxial cylinder in a triangular enclosure on flow characteristic and thermal performance of SiC-EG nanofluids
- To study the effect of volume fraction and Rayleigh number on heat transfer characteristic of SiC-EG nanofluids

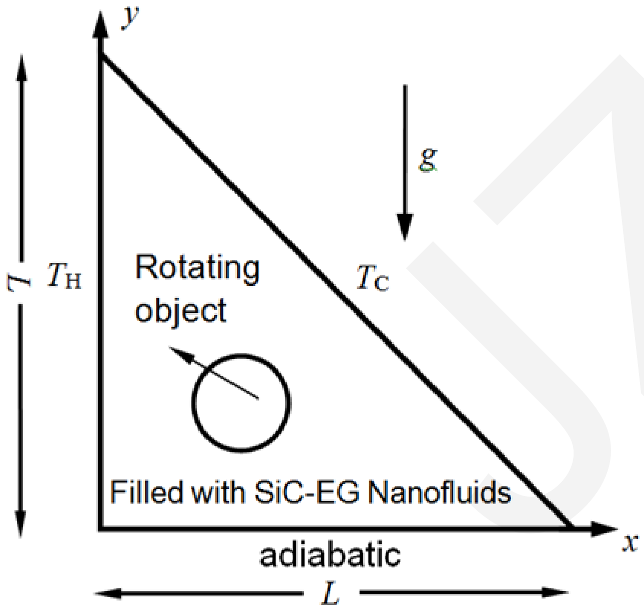

Fig. 1 Schematic diagram of the physical model

Table 1 Comparison of the thermal conductivity and viscosity between the values calculated by the Maxwell and Brinkman models and the experimental results for EG-SiC nanofluids as a function of SiC volume fractions

Φ	k (W/m·K)	k (W/m·K) (Maxwell, 1904)	μ (kg/m·s)	μ(kg/m·s) (Brinkman, 1952)
0	0.2510	0.2510	0.02056	0.02056
0.01	0.2574	0.26366	0.02100	0.021083
0.02	0.2629	0.276577	0.02182	0.021625
0.03	0.2786	0.289761	0.02358	0.022187
0.04	0.3061	0.303219	0.02898	0.022769

■ Influence of rotating inner cylinder on flow characteristic

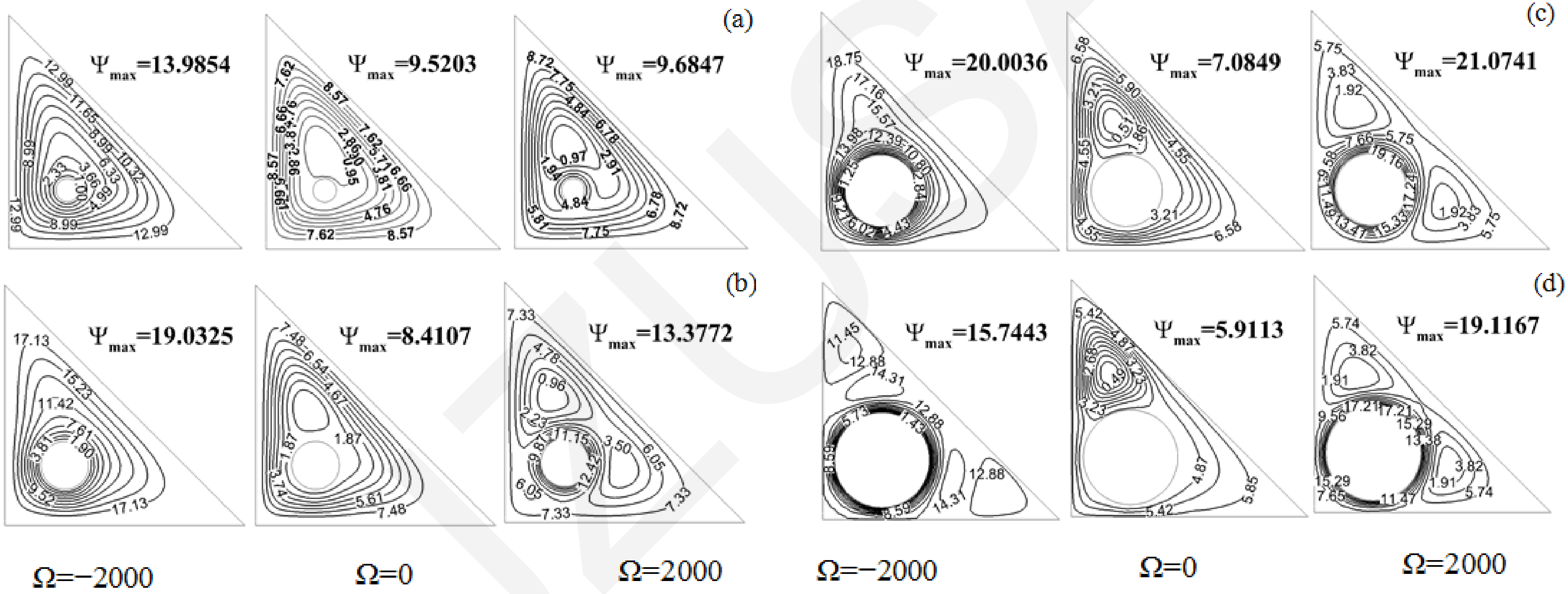

Fig. 2 Streamlines with respect to clockwise and anti-clockwise directions and different dimensionless rotational velocities at *Ra*=10^5, *φ*=0.02 for (a) *R*=0.05, (b) *R*=0.1, (c) *R*=0.15, (d) *R*=0.2

Influence of rotating inner cylinder on thermal performance

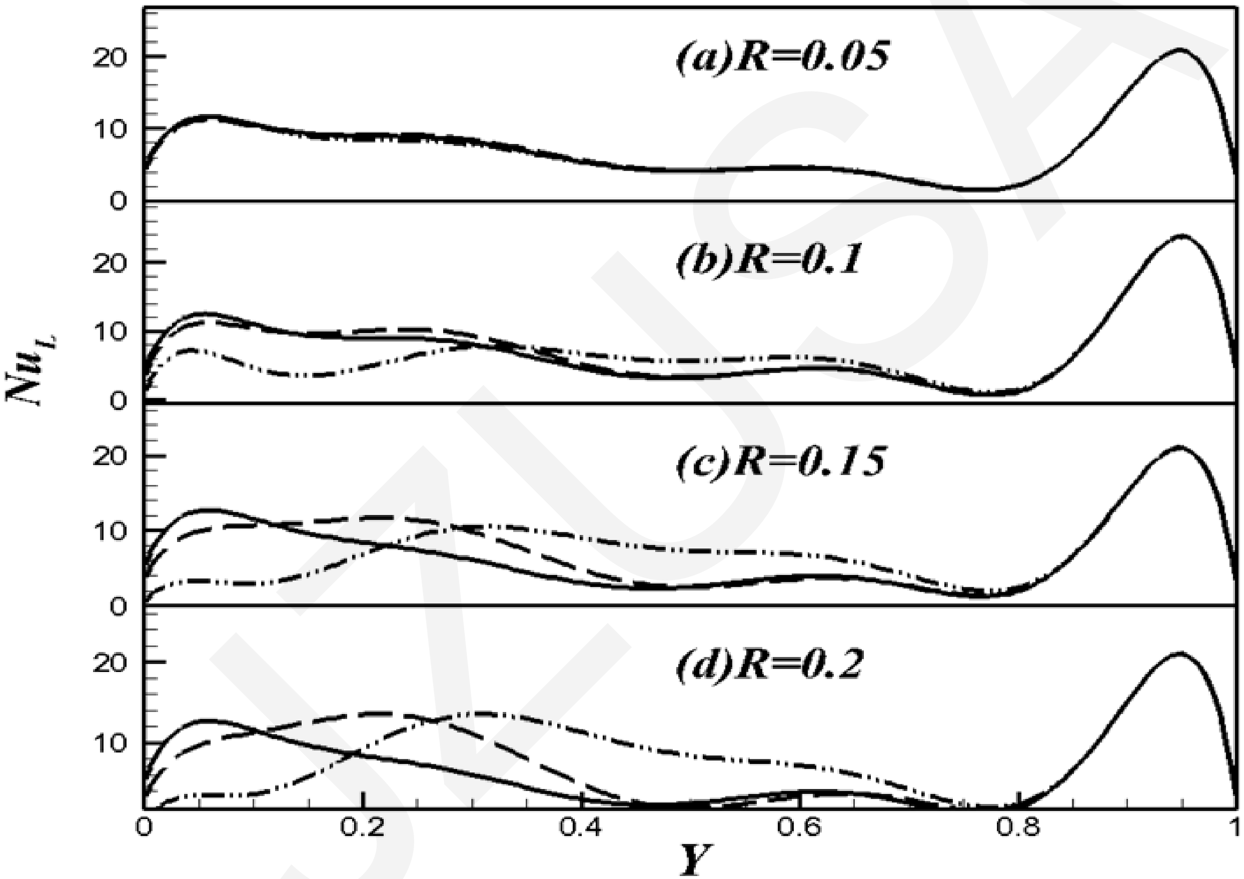

Fig. 3 Comparisons of local Nusselt number distribution along the hot surface with respect to different rotational velocities at *Ra*=10^5 and *φ*=0.02 for (a) *R*=0.05, (b) *R*=0.1, (c) *R*=0.15, (d) *R*=0.2

Influence of rotating inner cylinder on thermal performance

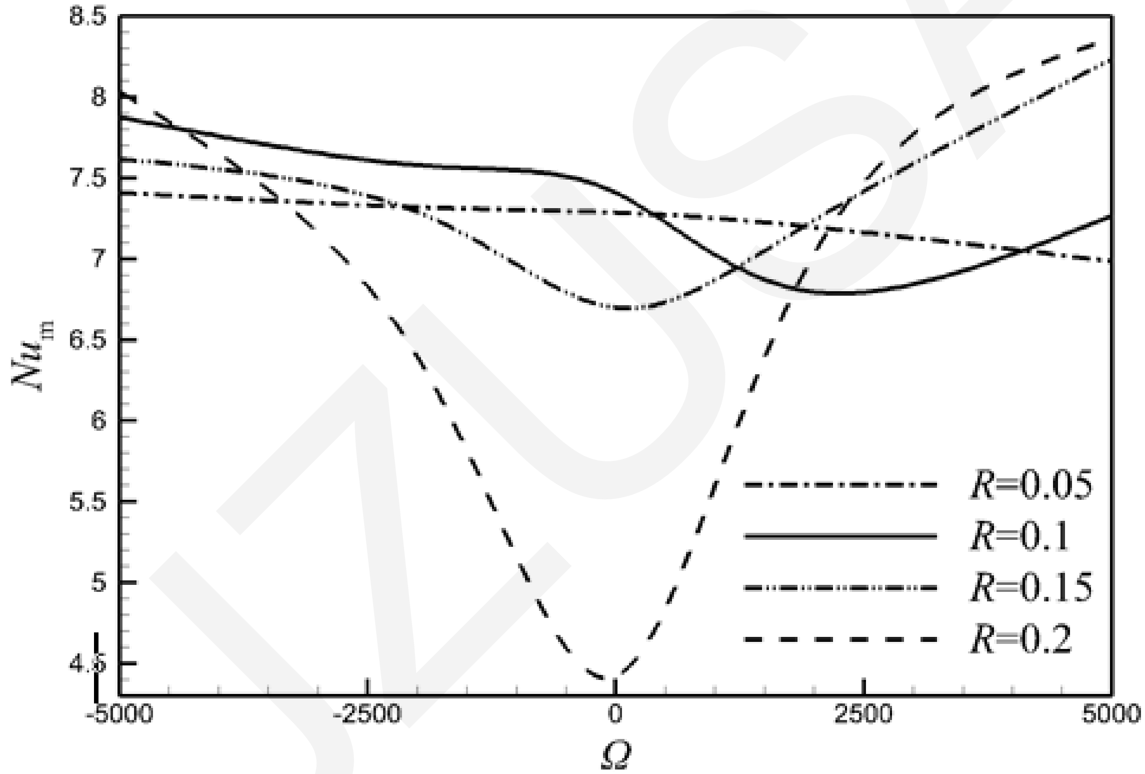

Fig. 4 Variation of average Nusselt number dependence on the dimensionless rotational velocity for different dimensionless radii at φ=0.02, Ra=10^5

■ Influence of volume fraction and Rayleigh number on heat transfer characteristic of SiC-EG nanofluids

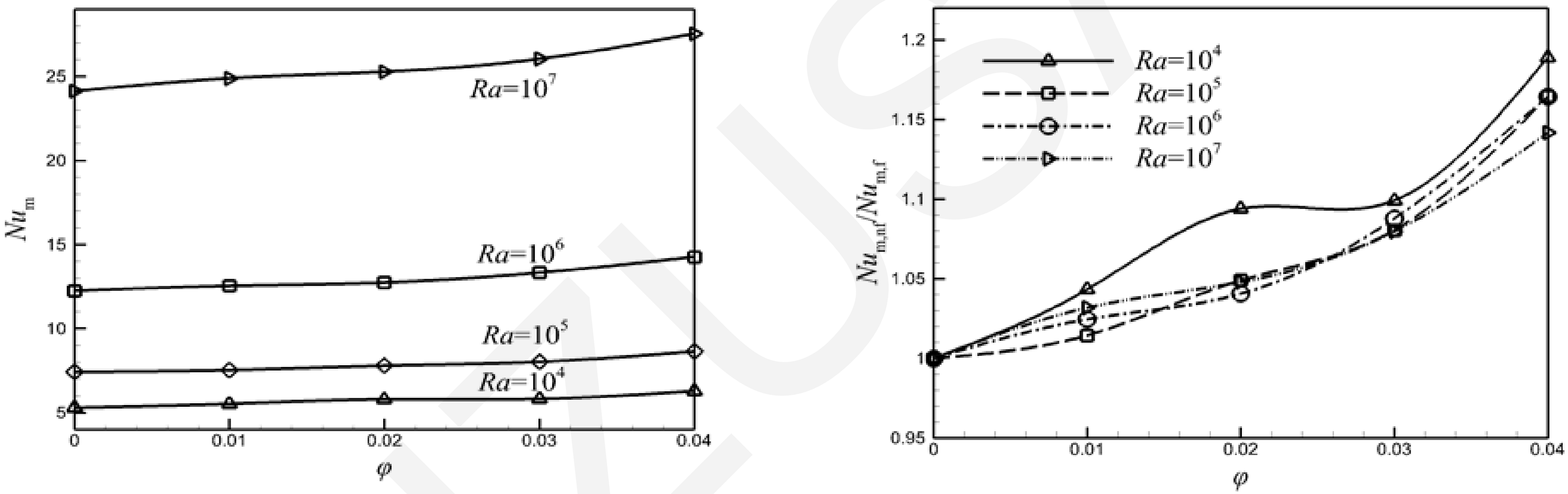

Fig. 5 Variation of (a) average Nusselt number and (b) normalized Nusselt number $Nu_{m,nf}/Nu_{m,f}$ with respect to the volume fraction of the nanoparticles for different Rayleigh numbers at Ω=1000, R=0.1

Conclusions

- **Rotation of the inner cylinder has benefits for improving the heat transfer rate when the rotation direction is same as the flow direction induced by natural convection. But the opposite rotational direction of the cylinder with lower rotational speed is prejudicial. Moreover, enhancement of heat transfer is obtained when forced convection becomes the dominant mechanism.**

- **The heat transfer rate in the enclosure keeps increasing by adding SiC nanoparticles for a fixed dimensionless rotation speed and it is more pronounced at low Rayleigh numbers where heat conduction is more dominant.**