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Numerical Analysis of Supercritical CO_2 Flow and Heat Transfer Inside Porous Structures on a Microchip

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ABSTRACT

With the development of supercritical fluid technology, supercritical CO_2 has great applications in carbon sequestration, soil remediation, recovery of petroleum gas, material extraction in industrial processes, and product pure drug nanoparticles/nanocrystals. In these applications, the flow and heat transfer, phase change of sCO_2 in porous media are involved. Combined with the previous research methods, we establish a three-dimensional microchannel chip porous media model. Using the numerical simulation method, we study the flow and heat transfer characteristics of sCO_2 in the microchannel chip porous media under different working conditions. The temperature, pressure and density distribution are obtained under different working conditions. We also investigate the influence of inlet conditions such as mass flow and inlet temperature on pressure drop between inlet and outlet of porous media model and heat transfer coefficient between CO_2 and heating wall of microchannel chip. The results show that the increase of mass flow rate and inlet temperature will increase the pressure drop, while the increase of outlet pressure will decrease the pressure drop. The increase of mass flow will enhance heat transfer, while when the inlet temperature exceeds the critical temperature of CO_2, the increase of inlet temperature will inhibit heat transfer. The variation of heat transfer coefficient in different regions of the numerical model is also observed.

KEYWORDS

Supercritical CO_2; porous structures; fluid flow; heat transfer; numerical analysis

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