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The statistical second-order two-scale analysis method for conduction-radiation coupled heat transfer of porous materials

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Abstract: A new statistical second-order two-scale (SSOTS) method was presented for predicting the performances of conduction-radiation coupled heat transfer of porous materials with random distribution of pores. The statistical second-order two-scale formulation for the Rosseland problem of porous materials was discussed, and a statistical prediction algorithm for maximum heat flux density was brought forward. Besides, the validity of the proposed method by comparison with theoretical methods with simple numerical models was verified. Finally, macroscopic thermal properties for the porous ceramic materials with varying probability distribution models including volume fraction and spatial distribution model of pores were shown. The results show that the effective thermal conductivity parameters decrease and maximum heat flux density increases with the pores volume fraction increasing. What is more, the radiation is an important factor for heat transfer at a high temperature. It is also shown that the SSOTS method is valid to predict the performances of conduction-radiation coupled heat transfer of porous materials with random distribution of pores.

Keywords: the statistical second-order two-scale (SSOTS) method conduction-radiation coupled heat transfer heat flux density Rosseland equation porous materials

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[1] Hashin Z, Shtrikman S. A variational approach to the theory of the effective magnetic permeability of multiphase materials [J]. Journal of Applied Physics, 1962, 33: 3125-3131.
[2] Landauer R. The electrical resistance of binary metallic mixtures [J]. Journal of Applied Physics, 1952, 23: 779-784.
[3] Kirkpatrick S. Percolation and conduction [J]. Review of Modern Physics, 1973, 45(4): 574-588.
[4] Torquato S. Random heterogeneous materials: Microstructure and macroscopic properties [M]. New York: Springer, 2002.
[5] Zhao C Y, Lu T J, Hodson H P. Thermal radiation in ultralight metal foams with open cells [J]. International Journal of Heat and Mass Transfer, 2004(47): 2927-2939.
[6] Glicksman L R, Schuetz M, Sinofsky M. Radiation heat transfer in foam insulation [J]. International Journal of Heat and Mass Transfer, 1987, 30(1): 187-197.
[7] Grujicic M, Zhao C L, Biggers S B, Kennedy J M, Morgan D R. Suitability of a coal-derived carbon-based foam for use in thermal protection systems of common aero vehicles [J]. Multidiscipline Modeling in Materials and Structures, 2007, 3(1): 1-26.
[8] Daryabeigi K. Analysis and testing of high temperature fibrous insulation for reusable launch vehicles //37th AIAA Aerospace Sciences Meeting and Exhibit. American: AIAA, 1999.
[9] , , . 3D C/SiCc ϵ [J].
c ʌ , 2008, 25(5): 79-84. Wu Wenming, Cheng Laifei, Wang Wei. Thermal radiation properties of 3D C/SiC composites [J]. Acta Materiae Compositae Sinica, 2008, 25(5): 79-84.
[10] , ʌ .Ő oʌ ʌ ȶ[J].c ʌ ,
2005, 22(2): 130-136. Tang Yuye, Xue Mingde. Thermo-mechanical characteristics analysis of sandwich panel with honeycomb core [J]. Acta Materiae Compositae Sinica, 2005, 22(2): 130-136.
[11] Bensoussan A, Lions J L, Papanicolaou G. Asymptotic analysis for periodic structure [M]. Amsterdam: North-Holland Publishing Company, 1978.
[12] Oleinik O A, Shamaev A S, Yosifian G A. Mathematical problems in elasticity and homogenization [M]. Amsterdam: North-Holland Publishing Company, 1992.
[13] Cui J Z, Shin T M, Wang Y L. Two-scale analysis method for bodies with small period configuration [J]. Acta Mechanica Sinica, 1999, 7(6): 601-614.
[14] Cui J Z, Yu X G. The two-scale method for identifying mechanical parameters of composite materials with periodic configuration [J]. Acta Mechanica Sinica, 2006, 22: 581-594.
[15] Li Y Y, Cui J Z. Two-scale analysis method for predicting heat transfer performance of composite materials with random grain distribution [J]. Science in China Series A: Mathematics, 2004, 47: 101-110.
[16] Yu Y, Cui J Z, Han F. An effective computer generation method for the composites with random distribution of large numbers of heterogeneous grains [J]. Composites Science and Technology, 2008, 68: 2543-2550.
[17] Yu Y, Cui J Z, Han F, Chen Y. The two-order and two-scale method for heat conduction properties of composite materials with random distribution of grains [J]. Computer and Experimental Simulations in Engineering and Science, 2008, 2: 19-34.
[18] Yu Y, Cui J Z, Han F. The statistical second-order two-scale analysis method for heat conduction performances of the composite structure with inconsistent random distribution [J]. Computational Materials Science, 2009, 46: 151-161.
[19] Han F, Cui J Z, Yu Y. The statistical second-order two-scale method for mechanical properties of statistically inhomogeneous materials [J]. International Journal for Numerical Methods in Engineering, 2010, 84(8): 972-988.
[20] . ϵ ?Чo.:
ʮ ʌ , 2006. Yan Changhai. Thermal insulating mechanism and research on thermal insulating efficiency of thermal insulations of metallic thermal protection system . Harbin: Harbin Institute of Technology, 2006.
[21] Doermann D, Sacadura J F. Heat transfer in open cell foam insulation [J]. Journal of Heat Transfer, 1996, 118: 88-93.
[22] Zhang Q F, Cui J Z. Existence theory for Rosseland equation and its homogenized equation [J]. Applied Mathematics and Mechanics, 2012, 33(12): 1595-1612..
[23] . c Rosseland ? ? ? . :
йʌ σʌ ʌ oσ, 2012. Zhang Qiaofu. Multi-scale analysis method for Rosseland-type equation of periodic composites . Beijing: Academy of Mathematics and Systems Sciences, Chinese Academy of Sciences, 2012.

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6ϲ ϵ [J]. ϲ ѧ , 2008,25(1): 64-68
2 , , , . ά "
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3 , ӳ *, ? ϲ . "
[J]. ϲ ѧ , 2010,27(4): 152-159
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