interface in two-phase (continuous and discrete phases) heterogeneous materials with constant heat flux thermal boundary condition. The analytical prediction is validated with numerical simulations results based on the finite difference method (FDM) as well as approximate solutions obtained using the heat balance integral method, with excellent agreement achieved. It is demonstrated that the inclusion of gaseous pores causes a significantly faster phase change process resulting from the decreased effective density of the bulk material and the temporal propagation of a solidification front exhibits a monotonic but non-linear trend. Further, the full solidification time decreases monotonically but nonlinearly as the porosity is increased, suggesting that porosity plays a crucial role in the solidification process: even a low porosity can significantly accelerate the solidification process.

tjlu@mail.xjtu.edu.cn

14:01–207

A new triple porosity seepage model in coalbed

Yuewu Liu[*,†], *Congcong Niu*[**], *Qiang Cai*[**], *HaiSheng Li*[**], *Xiangyong Men*[+]
[*]*Institute of Mechanics, Chinese Academy of Sciences, Beijing, China*
[**]*Beijing Technology and Business University, Beijing, China*
[+]*Coalbed methane Ltd. Company, Petrochina, Beijing, China*

Based on the analysis of macro and micro structure of the coalbed and comprehensive research on dual-porosity and triple-porosity models at home and abroad, three new triple-porosity models were proposed by considering the geological characteristics of coalbed and desorption law of CBM in China. The triple-porosity contains coal matrix, micro-fracture and structural fracture/cleat. By analyzing the coal samples from different region in China, it concludes that coal was cut into different shapes of blocks, which consist of cube/sphere, layer and cylinder, by structural fracture/cleat. The blocks as basic unit of coal are referred to matrix 1. There are uniform micro-unit and miro-fracture within the matrix 1, and the micro-unit is called matrix 2. Two kinds of CBM desorption phenomena include steady and unsteady desorption.

lywu@imech.ac.cn

14:04–207

Modeling pH-sensitive hydrogel for microfluidic control

Tao He[*], *Meie Li*[**], *Jinxiong Zhou*[*,†]
[*]*State Key Laboratory for Strength and Vibration of Mechanical Structures and School of Aerospace, Xi'an Jiaotong University, Xi'an, China*
[**]*State Key Laboratory for Mechanical Behavior of Materials and School of Materials Science and Engineering, Xi'an Jiaotong University, Xi'an, China*

Following a recently developed theory for constrained swelling of pH-sensitive hydrogel and the finite element user-subroutine technique, we modeled deformation and contacts of pH-sensitive hydrogels for real purpose microfluidic flow control systems. A jacket valve consisting of three cylindrical hydrogels coated on three fixed pillars and a hybrid hydrogel/PDMS system are modeled and analyzed in this paper. We present deformation and multiple contacts of the hydrogel based flow control systems when pH of external solution is switched to various values. Also included is the pressure in the contacts, stress distribution, sensitivity of swelling ratio with respect to pH values, and in addition the influence of initial fabrication imperfections. The presented results provide helpful guidance for the design, fabrication and optimization of pH-sensitive hydrogel devices for microfluidic flow control.

jxzhouxx@mail.xjtu.edu.cn

14:07–207

A theoretical framework for modeling the chemo-mechanical behavior of porous media with multiphases and multispecies

Changfu Wei[†], *Xiating Feng*
State Key Laboratory of Geomechanics and Geotechnical Engineering, Institute of Rock and Soil Mechanics, Chinese Academy of Sciences, Wuhan, China

A chemo-mechanical theory of porous media with multiphase and multispecies is developed based on the hybrid theory of mixtures. It is shown that the coupled processes in porous media such as skeletal deformation, fluid flow, heat conduction, material diffusion, chemical reaction, phase transition, pressure solution, and so on, can be consistently described within this unique theoretical framework. Central to the theory is a general expression for the electrochemical potential of species, based on which the colligative properties of porous media are discussed, including osmotic pressure, Donnan effect, Gibbs–Thomas effect, supercooling and superheating. In particular, the components of pore fluid pressure are identified and formulated, and the concept of effective stress is clarified. It is found that whenever electro-chemical effect comes into play, the total pore pressure can not be directly measured via a traditional transducer. The impact of this result is far-reaching, since the concept of effective stresses is generally adopted in theoretically modeling and numerically simulating the coupled processes in porous media.

cfwei@whrsm.ac.cn

14:10–207

Thermal stresses around a cylindrical hole in a transversely isotropic poroelastic medium considering local thermal non-equilibrium

Zhihe Jin[*], *Luwu He*[**,†]
[*]*Department of Mechanical Engineering, University of Maine, Orono, USA*
[**]*School of Mechanical and Power Engineering, East China University of Science and Technology, Shanghai, China*

This work presents a local thermal non-equilibrium (LTNE) poroelasticity model for transversely isotropic porous media and investigates the thermally induced pore pressure and thermal stresses around a cylindrical hole in an infinite porous medium

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