14:18–210B

Rapid cell separation in double spiral microfluidic channels

*Chao Liu**, *Jiashu Sun***, *Xingyu Jiang***, *Guoqing Hu**,†

**LNM, Institute of Mechanics, Chinese Academy of Sciences, Beijing, China*

***CAS Key Lab for Biological Effects of Nanomaterials and Nanosafety, National Center for NanoScience and Technology, Beijing, China*

A double spiral microfluidic platform is developed to allow precise and continuous cell separation in a compact format with throughput comparable to traditional techniques. The Dean drag force induced by the curved microchannels acts on particles and cells to compete with the inertial lift force, resulting in different equilibrium positions for particle and cells with different sizes. A numerical model to track the particle/cell trajectories in the 3D Dean flows is developed, by taking account of the effects of the key hydrodynamic forces. The numerical simulation is validated against the experimental observations and serves as an effective tool for microfluidic chip design and optimization. The separation chip is characterized with the binary mixture of 5 and 10 micron diameter polystyrene beads at different flow rates. Finally, successful separation and concentration of 4T1 cells from the murine blood cells at a high throughput is achieved using the same microfluidic chips.

guoqing.hu@imech.ac.cn

14:21–210B

A hybrid computational model to predict separation of cells in hydrodynamic metamaterials

*Wentao Wang**,†, *Yi-Kuen Lee**,**

**Department of Mechanical Engineering, Hong Kong University of Science and Technology, Hong Kong, China*

***Joint KAUST-HKUST Micro/Nanofluidics Laboratory, Hong Kong University of Science and Technology, Hong Kong, China*

The separation of biological cells or minute particles in hydrodynamic metamaterials, analogous to photonic counterpart, was investigated by a new hybrid model: FVM based computational model in conjunction with an in-house-built computer code. This hybrid model can simulate the interaction of particles in hydrodynamic metamaterials. By examining the streamline of the fluid flow and the collision of particles within the metamaterial, we confirm that separation of particles originates from the hydrodynamic force and interaction between particles and microstructure in the metamaterial. The simulation results were consistent with the experimental data reported in the literature. The proposed model is promising for the design optimization of hydrodynamic metamaterials in the future.

meyklee@ust.hk

FS05: Electro- and magnetomechanical systems
14:30–14:54, Tuesday, 21 August
Katie Bertoldi, USA, Chair
Yongdong Pan, China
Room: 210B

14:30–210B

A pathway of hardness enhancement in transition-metal borides

*Zhao Fu**, *Yongcheng Liang**,†, *Zheng Zhong***

**College of Engineering Science and Technology, Shanghai Ocean University, Shanghai, China*

***School of Aerospace Engineering and Applied Mechanics, Tongji University, Shanghai, China*

The mechanical behaviours of OsB, Os_2B_3 and OsB_2 are systematically investigated by the first-principles calculations. It is found that the changing trends of bulk modulus and hardness are completely different for OsB, Os_2B_3 and OsB_2, which indicates that the underlying sources of incompressibility and hardness are fundamentally different. The incompressibility is related to elastic deformation that is closely associated with valence electron density, whereas the hardness depends strongly on plastic deformation that is determined by bonding nature. It is shown that incorporating small boron atoms into osmium should be a valid pathway of hardness enhancement. This strategy is in principle also applicable to other transition metal borides, carbides, nitrides.

ycliang@shou.edu.cn

14:33–210B

Directly resolving particles in an electric field and applications to heterogeneous dielectric materials and biomedical engineering

Qianlong Liu†, *Kenneth L. Reifsnider*

**DOE Energy Frontier Research Center, Department of Mechanical Engineering, University of South Carolina, Columbia, USA*

We extend Prosperetti's seminal Physalis method for finite-sized particles in fluid flow to directly resolve dielectric particles in an electric field. The method can be used to accurately predict, for the first time, the local charge distribution, force and torque on particles and to accurately account for the mutual fluid-particle, particle-particle, and particle-boundary interactions. The method is very accurate and able to satisfy exactly the discontinuous interface conditions, efficient to simulate up to one million particles using a PC, and unique in the computational world. These features make the method especially important to applications to heterogeneous dielectric materials and biomedical engineering.

liu246@mailbox.sc.edu