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Report on the 1st International Conference on Micro/Nanomachines

Fangzhi Mou, Ming Luo and Jianguo Guan*

The 1st International Conference on Micro/Nanomachines (ICMM 2017) was held in Wuhan, China from August 25 to 28, 2017. The conference was co-organized by Prof. Jianguo Guan from Wuhan University of Technology (WUT), China, Prof. Joseph Wang from University of California San Diego (UCSD), USA and Prof. Peer Fischer from Max Planck Institute (MPI) for Intelligent Systems, Germany. It focused on the theme “Propulsion at the Micro/nanoscale”. ICMM 2017 brought together researchers from different disciplines to discuss how micro/nanomachines can be built, powered and function like their biological counterparts. The discussed topics include micro/nanomachines that are driven by local chemical reactions, external field and biological cells. There were over 50 talks and 50 posters in this conference. Apart from the questions of fabrication, energy conversion, and control at length scales where Brownian motion is of importance, a number of talks also discussed potential fields of application for these synthetic micro/nanomachines.

In the first keynote, Prof. Thomas E. Mallouk from Pennsylvania State University discussed the cross-diffusion model to explain chemotaxis in noncatalytic systems. He also demonstrated the control of motor orientation, assembly, and strong upstream or downstream rhotaxis of micro/nanomotors using chemical or acoustic propulsion. Prof. Joseph Wang from UCSD first introduced the past and present development of micro/nanomachines, then highlighted their attractive features in various applications, including using them to write, repair, image, deliver and destroy.

Prof. Peer Fischer from MPI for Intelligent Systems demonstrated that light responsive titania-silica Janus colloids can make the structures and assemblies that usually cannot be found in equilibrium systems, followed by their latest monolithic acoustic holograms, which can be used to generate diffraction-limited acoustic pressure fields and thus arbitrary ultrasound beams. The new acoustic holograms will enable new capabilities in beam-steering and the contactless transfer of power, improve medical imaging, and drive new applications of ultrasound.

Prof. Toshio Fukuda from Nagoya University delivered an informative talk on micro/nanorobotic manipulation technologies for carbon nanotube engineering, single cell surgery and 3D cell bio-assemble, as well as their-based bio-driven micro/nanomachines.

Prof. Oliver G. Schmidt from IFW Dresden discussed the opportunities and challenges of micromotors with a subsequent demonstration of the multilayer self-rolled micromotors and the magnetically guided spermatozoid-driven swimmers, showing attractive in vivo prospects of micro/nanomachines.

Prof. John F. Brady from California Institute of Technology (Caltech) discussed the origin of a new source of stress that is responsible for self-assembly and pattern formation in active matter systems.

Prof. Liangfang Zhang from UCSD highlighted a revolutionary cell membrane coating technology, which can be applied to various substrates with different types of cell membranes, endowing micro/nanomotors with a fully biocompatible surface and biomimetic functions for diverse medical applications.

Prof. Yanlei Yu from Fudan University gave an engaging presentation on photodeformable liquid crystal polymers, a promising material for the fabrication of soft actuators, which could easily achieve sophisticated 3D motions by light illumination, offering a considerable promise for optofluide microchips.

Prof. Fangzhi Mou from WUT summarized the design strategies of light-controlled micro/nanomotors, followed by the light controlled dynamic assembly of colloidal particles. Furthermore, he also highlighted the swarming behaviors and programmable collective motions of light-driven micromotors.

Prof. Qiang He from Harbin Institute of Technology (HIT) detailed that living cells with intrinsic chemotaxis capability such as neutrophils could be turned into self-guided biohybrid micromotors by integrating E. coli membrane camouflaging mesoporous silica nanoparticles (MSNPs) for actively seeking sites of diseases and targeted drug transport.

By integrating MSNPs with catalytic/bio-catalytic materials, Prof. Xing Ma from HIT (Shenzhen) introduced MSNP as micro/nano-carrier for controlled drug/gene co-delivery and photodynamic therapy for cancer treatment.

Dr. Wei Gao from UCSD (now Caltech) presented functionalization of self-propelled zinc micromotors. He reported the first in vivo study of artificial micromotors by using a mouse model, opening the door to in vivo evaluation and clinical applications of these synthetic motors.

Compared with most investigations focusing on solid micro/nanomachines, Prof. Jing Liu from Tsinghua University delivered an interesting presentation of self-powered liquid metal droplet machines. He demonstrated that injecting the EGaIn alloy fueled with aluminum to the desired electrolyte would break up the alloy into droplet motors by converting chemical energy into mechanical power.

This conference values the opportunity to identify rising young scientists. For example, Dr. Jinxing Li from UCSD was awarded by ICMM 2017 as the recipient of the “Young Scientist Innovation Award”. He presented a lecture titled “Nanorobotic Lithography and Imaging”, demonstrating an engaging application. Mr. Jemish Parmar from Prof. Samuel Sánchez group won the first place of the “Best Poster Awards”. The second and third prize winners were awarded to Mr. Haifeng Xu from IFW Dresden and Mr. Borui Xu from Fudan University, respectively.

ICMM 2017 attracted over 200 participants from 14 countries and regions and was the largest international conference ever held on micro/nanomachines. Its success indicates that micro/nanomachines are an active and topical area of research that promises to have major impact in many fields. ICMM was a perfect venue for researchers to share their latest results and build friendships, establish collaborations and spark new ideas, which are expected to be the basis of the next meeting on micro/nanomachines.

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