FOREWORD

Focus on Novel Nanoelectromechanical 3D Structures: Fabrication and Properties

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Microelectromechanical systems (MEMS) are widely used small electromechanical systems made of micrometre-sized components. Presently, we are witnessing a transition from MEMS to nanoelectromechanical systems (NEMS), which comprise devices integrating electrical and mechanical functionality on the nanoscale and offer new exciting applications. Similarly to MEMS, NEMS typically include a central transistor-like nanoelectronic unit for data processing, as well as mechanical actuators, pumps, and motors; and they may combine with physical, biological and chemical sensors. In the transition from MEMS to NEMS, component sizes need to be reduced. Therefore, many fabrication methods previously developed for MEMS are unsuitable for the production of high-precision NEMS components. The key challenge in NEMS is therefore the development of new methods for routine and reproducible nanofabrication. Two complementary types of method for NEMS fabrication are available: 'top-down' and 'bottom-up'. The top-down approach uses traditional lithography technologies, whereas bottom-up techniques include molecular self-organization, self-assembly and nanodeposition.

The NT2008 conference, held at Ishikawa High-Tech Conference Center, Ishikawa, Japan, between 23–25 October 2008, focused on novel NEMS fabricated from new materials and on process technologies. The topics included compound semiconductors, small mechanical structures, nanostructures for micro-fluid and bio-sensors, bio-hybrid micro-machines, as well as their design and simulation.

This focus issue compiles seven articles selected from 13 submitted manuscripts. The articles by Prinz *et al* and Kehrbusch *et al* introduce the frontiers of the top-down production of various operational NEMS devices, and Kometani *et al* present an example of the bottom-up approach, namely ion-beam induced deposition of MEMS and NEMS. The remaining articles report novel technologies for biological sensors. Taira *et al* have used manganese nanoparticles to improve the chemical analysis of biological samples by laser desorption/ionization mass spectrometry. Matsumoto *et al* have prepared sugar microarrays via click chemistry and have applied this to the detection and characterization of proteins. Yoshimura *et al* have expanded the single-nucleotide polymorphism typing method to differentiate genes from various food crops, such as indica and japonica rice. Finally, Takashi *et al* have designed a nanoparticle-based strip sensor, which can be used for rapid evaluation of the psychological condition of animals and humans.

We hope that this focus issue will help readers to understand, from a materials science viewpoint, different aspects of frontier research into NEMS.

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