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Pham Hoang Ngan, Dennis Valbjørn Christensen, Gerald Jeffrey Snyder, Le Thanh Hung, Søren Linderoth, Ngo Van Nong, and Nini Pryds

Towards high efficiency segmented thermoelectric unicouples [Advanced Materials Physics]

Thermoelectricity, a process of converting heat into electricity and vice versa, is important for its high potential for many applications. Both the conversion efficiency and working temperature range can be greatly improved by segmenting multiple materials. Here, the authors design high-efficient thermoelectric (TE) generators by segmenting today’s state-of-the-art TE materials. Their efficiencies are calculated at temperature spans of up to 1100 K, and the criterion for selecting compatible materials for segmentation is given.


Advanced CMOS devices: Challenges and implant solutions [Feature Article]

Colombeau et al. review the trends for advanced CMOS devices in terms of architectures and scalability. The article highlights the key process challenges for planar MOSFET and FinFET device technologies. The authors emphasize the need for advanced implant solutions to enable device scaling/performance as well as variability improvement. Especially, they discuss in detail the latest damage engineering solutions as well as materials modification (e.g., contact and strain engineering) to reduce leakage, improve drive current and improve process margin/device variability.

Gloria Tabacchi, Ettore Fois, Davide Barreca, and Alberto Gasparotto

CVD precursors for transition metal oxide nanostructures: molecular properties, surface behavior and temperature effects

The molecular origin of the behavior of a class of transition metal complexes, attractive as sources for the Chemical Vapor Deposition (CVD) growth of metal/metal oxide nanomaterials, is unraveled by integrated modeling studies. Tabacchi et al. show how the metal center affects the properties of a series of β-diketonate-diamine metal complexes (M = Fe, Co, Cu, Zn), by focusing on the growth-temperature influence on the first molecular activation stages. A key milestone of the present work is the observation of hot-surface induced molecular rolling for Zn(hfa)2TMEDA, the complex with the most symmetric coordination polyhedron in the gas phase.

Ola Nilsen, Ville Miikkulainen, Knut B. Gandrud, Erik Østreng, Amund Ruud, and Helmer Fjellvåg

Atomic layer deposition of functional films for Li-ion microbatteries [Feature Article]

Microbatteries are commonly based on the all-solid state concept consisting of thin layers of electroactive materials separated by a solid state electrolyte. Atomic layer deposition (ALD) has an inherent nature to deposit conformal and pin-hole free layers on complex geometrical shapes, an architecture most commonly adopted for microbattery designs. The Feature Article by Nilsen et al. gives an overview of ALD-type deposition processes of functional battery materials, including cathodes, electrolytes, and anodes with the aim of developing all-solid-state batteries. Deposition of Li-containing materials by the ALD technique appears challenging and the status of current efforts is discussed.

Template-assisted Co–Ni alloys and multisegmented nanowires with tuned magnetic anisotropy [Invited Article]


The study of nanostructured magnetic materials synthesized through electrochemical methods by employing anodic aluminum oxide membranes as patterned templates has recently attracted a huge attention. García et al. have electroplated Co$_{100-x}$Ni$_x$ (15 ≤ x ≤ 61) alloy nanowires of about 180 nm in diameter into the pores of hard-anodic nanoporous alumina membranes, as well as multisegmented Co$_{54}$Ni$_{46}$/Co$_{85}$Ni$_{15}$ nanowires with an approximate length of 300 nm per segment. The magnetic properties of the nanowire arrays were studied and correlated with the microstructural features of each alloyed/multisegmented system.

Heeyoung Jeon, Jingyu Park, Woochool Jang, Hyunjung Kim, Chunho Kang, Hyoseok Song, Honggi Kim, Hyungtak Seo, and Hyeongtag Jeon

Stabilized resistive switching behaviors of a Pt/TaO$_x$/TiN RRAM under different oxygen contents


Heeyoung Jeon and coworkers studied the self-compliant (SC) bipolar resistive switching (BRS) phenomenon of Pt/TaO$_x$/TiN geometries under different oxygen flow rates. As the oxygen content of the TaO$_x$ layer was increased, the device stability was significantly improved. According to X-ray photoelectron spectroscopy, Auger electron spectroscopy, and I–V results, the SCBRS behavior was led by the TiON interfacial layer. Higher oxygen content might form a more uniform TiON interfacial layer. Thus, the stability of the devices, including I–V characteristics, distribution and power consumption, was improved.

Kane M. O’Donnell, Tomas L. Martin, Mark T. Edmonds, Anton Tadich, Lars Thomsen, Jürgen Ristein, Christopher I. Pakes, Neil A. Fox, and Lothar Ley

Photoelectron emission from lithiated diamond [Feature Article]


One of the incredible properties of diamond is negative electron affinity: electrons excited in diamond can escape with no barrier to emission. In this Feature Article, the authors discuss a new way of generating negative electron affinity on diamond using lithium and present a summary of the work that was done to understand lithiated diamond surfaces.

Qinghua Hu, Shantang Liu, and Yongfu Lian

Sensors for carbon monoxide based on Pd/SnO$_2$/CNT nanocomposites


In this study, a sol–gel method was used to synthesize a carbon nanotube (CNT) that was coated by Pd$^{2+}$-doped SnO$_2$ (Pd$^{2+}$/SnO$_2$/CNT nanocomposite) to prepare a carbon monoxide gas sensor. The results revealed that a 1.0 mol% Pd$^{2+}$ doping of SnO$_2$ and a CNT/Sn molar ratio of 0.12 exhibited high sensitivity, selectivity, repeatability, a low limit of detection, and a fast response-recovery time to CO at 100 °C. In order to explain the chemical state of Pd$^{2+}$ on sensing performance, an in situ reduction was formulated; the results indicated that Pd$^{2+}$ doping is the key to promoting sensitivity.