MRS JOURNAL HIGHLIGHTS

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The "Rock of Randomness": A physical oracle for securing data off the digital grid

Gideon Samid, Gary E. Wnek

The encryption of data and manufacturability can be used to define new functions that enable security embedment in product features. In the area of polymer materials applied to 3D printing, this will be an interesting demonstration which may have consequences for how polymer materials are deemed important beyond their thermo-mechanical or chemical properties.
https://doi.org/10.1557/mrc.2019.8

Self-healing liquid-infused surfaces with high transparency for optical devices

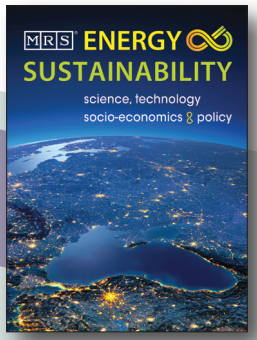
Meiling Zhang, Qi Liu, Jingyuan Liu, Jing Yu, Jun Wang

Glass surfaces are important for display and solid state function as well as for constant contact with an oxidizing environment. Controlling the surface anti-fouling behavior ensures high transmission and transparency. Self-cleaning behavior is a complement to enabling performance even in demanding and fouling environments.
https://doi.org/10.1557/mrc.2018.241

Versatile applications of three-dimensional objects fabricated by two-photon-initiated polymerization

Cheol Woo Ha, Prem Prabhakaran, Kwang-Sup Lee

High resolution 3D printing which can be achieved by two-photon polymerization will enable functionality and design complexity all the way to 100 nm resolutions suitable for devices, sensors, nanofluidics, and other applications. This review further emphasizes the potential of this method to enable new combinations of materials and printing parameters. https://doi.org/10.1557/mrc.2018.218



Implications of sustainability for the United States light-duty transportation sector

Chris Gearhart

A significant fraction of a necessary reduction in carbon emissions must come from the transportation sector. Gearhart assesses the consensus of the scientific and engineering communities concerning the potential for the United States' light-duty transportation sector to meet a goal of 80% reduction in vehicle emissions and examine what it will take to meet this target.
https://doi.org/10.1557/mre.2016.8

Climate change and fossil fuel: An examination of risks for the energy industry and producer states

Jim Krane

Compiling and categorizing the climate risk facing the fossil fuel industry, Krane finds the risk differs greatly among coal, oil, and natural gas, as well as between the developing and developed world. He identifies heightened risk for the coal industry and reduced risk for oil businesses, due to its lack of substitutes.
https://doi.org/10.1557/mre.2017.3

Energy use by air taxis and drones for parcel delivery, is it practical? Is it sustainable?

Peter Rez

Aircraft that take off and land vertically with horizontal propellers use more energy than conventional aircraft whose lift is provided by wings. Although the ratio of payload and fuel to total aircraft mass for the proposed Amazon drone is not that different from that for a Boeing 747, range and time in the air is much less. In principle, a conventional aircraft powered by photovoltaic panels could match the performance of Amazon's drone. https://doi.org/10.1557/mre.2018.5

https://doi.org/10.1557/mrs.2019.81 Published online by Cambridge University Press

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Multiscale imaging and transport modeling for fuel cell electrodes

Jasna Jankovic, Shawn Zhang, Andreas Putz, Madhu S. Saha, Darija Susac

3D imaging of the gas diffusion layer, microporous layer, and catalyst layers of a proton-exchange membrane fuel cell (PEMFC) provides critical multiple length scale information for numerical simulations of the overall electrical conductivity and performance of a PEMFC. Details of the electron tomography, focused ion beam–scanning electron microscopy, and 3D x-ray microscopy for multiscale 3D imaging are highlighted. https://doi.org/10.1557/jmr.2018.458

Interaction of water with oxide thin film model systems

Martin Sterrer, Niklas Nilius, Shamil Shaikhutdinov, Markus Heyde, Thomas Schmidt, Hans-Joachim Freund

JMR Focus Issue "Understanding Water-Oxide Interfaces to Harness New Processes and Technologies" demonstrates that water profoundly impacts oxide surface behavior. This paper reviews experimental and computational studies of well-defined oxide surfaces, and discusses fundamental water–oxide interactions such as adsorption modes (molecular versus dissociative), formation of long-range ordered structures, and dissolution processes. https://doi.org/10.1557/jmr.2018.454

High-entropy functional materials

Michael C. Gao, Daniel B. Miracle, David Maurice, Xuehui Yan, Yong Zhang, Jeffrey A. Hawk

JMR Focus Issue "Fundamental Understanding and Applications of High-Entropy Alloys" shows exciting fundamental and structural property advances with HEAs. This paper reviews functional properties including soft magnetic, magnetocaloric, physical, thermoelectric, superconducting, and hydrogen storage. Computational modeling and tuning of composition through substitutional or interstitial mixing extend the concept of high configurational entropy to a wide range of intermetallics, ceramics, and semiconductors through the isostructural design approach. https://doi.org/10.1557/jmr.2018.323

Rheological characterization of alginate based hydrogels for tissue engineering

Pengfei Duan, Nehir Kandemir, Jiajun Wang, Jinju Chen

Hydrogels are critical materials for biomedical applications, from contact lenses to tissue engineering, with mechanical properties from stiff to very compliant, allowing for specific applications. Here a commercial rheometer is used to measure the mechanical response of hydrogels with alginate concentrations ranging from 0.5 to 5%, showing changes in storage and loss modulus that vary by almost two orders of magnitude. All their gels show shear thinning behavior. https://doi.org/10.1557/adv.2017.8

Energy dispersive x-ray diffraction (EDXRD) of $Li_{1.1}V_3O_8$ electrochemical cell

Qing Zhang, Andrea M. Bruck, David C. Bock, Jing Li, Eric A. Stach, Esther S. Takeuchi, Kenneth J. Takeuchi, Amy C. Marschilok

Characterization of the phase transformations that occur during battery charging are crucial to controlling and improving battery performance. Here, the first energy dispersive x-ray diffraction study found phase changes with lithiation, but no evidence of localization within the constructed coin cells, providing insight into planning future *in operando* studies. https://doi.org/10.1557/adv.2017.54

A new subcritical nanostructure of graphene—Crinkle-ruga structure and its novel properties

Ruizhi Li, Mrityunjay Kothari, Alexander K. Landauer, Moon-Hyun Cha, Heemin Kwon, Kyung-Suk Kim

Graphene is shown to form a specific "crinkled" structure, the unique out-of-plane morphology, observed with AFM, which alters the electronic properties demonstrating both N and P type regions. This impacts interactions with C60 molecules and DNA chains, opening the door for future studies of controlled localized properties using nanoscale mechanics. https://doi.org/10.1557/adv.2018.432

https://doi.org/10.1557/mrs.2019.81 Published online by Cambridge University Press