



## Bioinspired synthesis of thermally stable and mechanically strong nanocomposite coatings

Guangping Xu, Hongyou Fan, Chad A. McCoy, Melissa M. Mills, Jens Schwarz

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Layered composites mimicking natural structures made of hard inorganic and soft organic layers show promise as high-strength shield materials. The authors synthesize layered nanocomposite coatings using silica and sugar-derived carbon mimicking the formation of a natural seashell structure. Hardness and elastic modulus values of more than 11 GPa and 120 GPa, respectively, and thermal stability up to 1150°C are reported. Sugar-derived carbon is cost-effective and environmentally friendly. <https://doi.org/10.1557/s43580-022-00245-y>

## Effect of size and shape on the elastic modulus of metal nanowires

Lilian Maria Vogl, Peter Schweizer, Gunther Richter, Erdmann Spiecker

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Mechanical size effects, in particular with respect to strength, have been well established. The authors demonstrate not only a significant influence of the size on the elastic properties of gold nanowires, but also a shape effect. Using *in situ* mechanical testing in scanning and transmission electron microscopes, the authors report both cases of softening and stiffening, depending on the interplay between size and shape of the wires. <https://doi.org/10.1557/s43580-021-00103-3>

## Characterizing the pressure response of microstructured materials for soft optical skins

Michael Portaro, Rio Brittny, Cindy Harnett

Soft optical pressure-mapping elastomeric skins have the potential to give robots a human-like tactile sense of their environment. The authors demonstrate how the microstructure of an elastomer layer controls its light transmission as a function of pressure. Using a microtextured silicone sheet, the authors show that the increasing pressure can be successfully transformed into increasing optical transmission. <https://doi.org/10.1557/s43580-022-00281-8>



## Advances in titanium bio-implants: Alloy design, surface engineering and manufacturing processes

Sarabjeet Singh Sidhu, Mohamed Abdel-Hady Gepreel, Marjan Bahraminasab

Metallic biomaterials for prostheses, devices, stents, wires, and implants offer excellent mechanical strength and resilience. Rapid advances with titanium (Ti)-based biomaterials are due to superior mechanical behavior, chemical properties, and biocompatibility. But the mechanical mismatch between bone and implant and the need for higher bioactivity leave room for improvement. Contributors to this Focus Issue discuss state-of-the art and novel ideas for producing added-value titanium implants focusing on new alloys, fabrication, surface treatment, and coatings. <https://doi.org/10.1557/s43578-022-00661-8>

## Understanding electro-mechanical-thermal coupling in solid-state lithium metal batteries via phase-field modeling

Zhe-Tao Sun, Shou-Hang Bo

Solid-state batteries, based on a solid electrolyte and an energy-dense metal anode, are promising next-generation energy-storage devices. Phase-field modeling strategies cover a much wider range of length scales compared to those of first principles and finite element methods, but cannot be directly applied to solid-state systems with strong coupling between different physical fields. The authors provide a brief introduction for electrochemists who are new to the phase-field method as well as simulation scientists who are new to solid-state batteries. <https://doi.org/10.1557/s43578-022-00558-6>

## Critical overview of polyanionic frameworks as positive electrodes for Na-ion batteries

Debolina Deb, Gopalakrishnan Sai Gautam

Sodium-ion batteries (NIBs) are an important alternative to lithium-ion batteries (LIBs) for developing cost-effective energy-storage systems less constrained by geographical supply chains. Analogous to LIBs, cathodes are critical in determining the energy density of NIBs, and layered transition-metal oxide compounds are widely used as NIB cathodes. However, the instability-driven irreversible phase transitions in layered frameworks have necessitated exploration of rigid structural frameworks resistant to structural changes with Na exchange. <https://doi.org/10.1557/s43578-022-00646-7>