

# MRS Bulletin

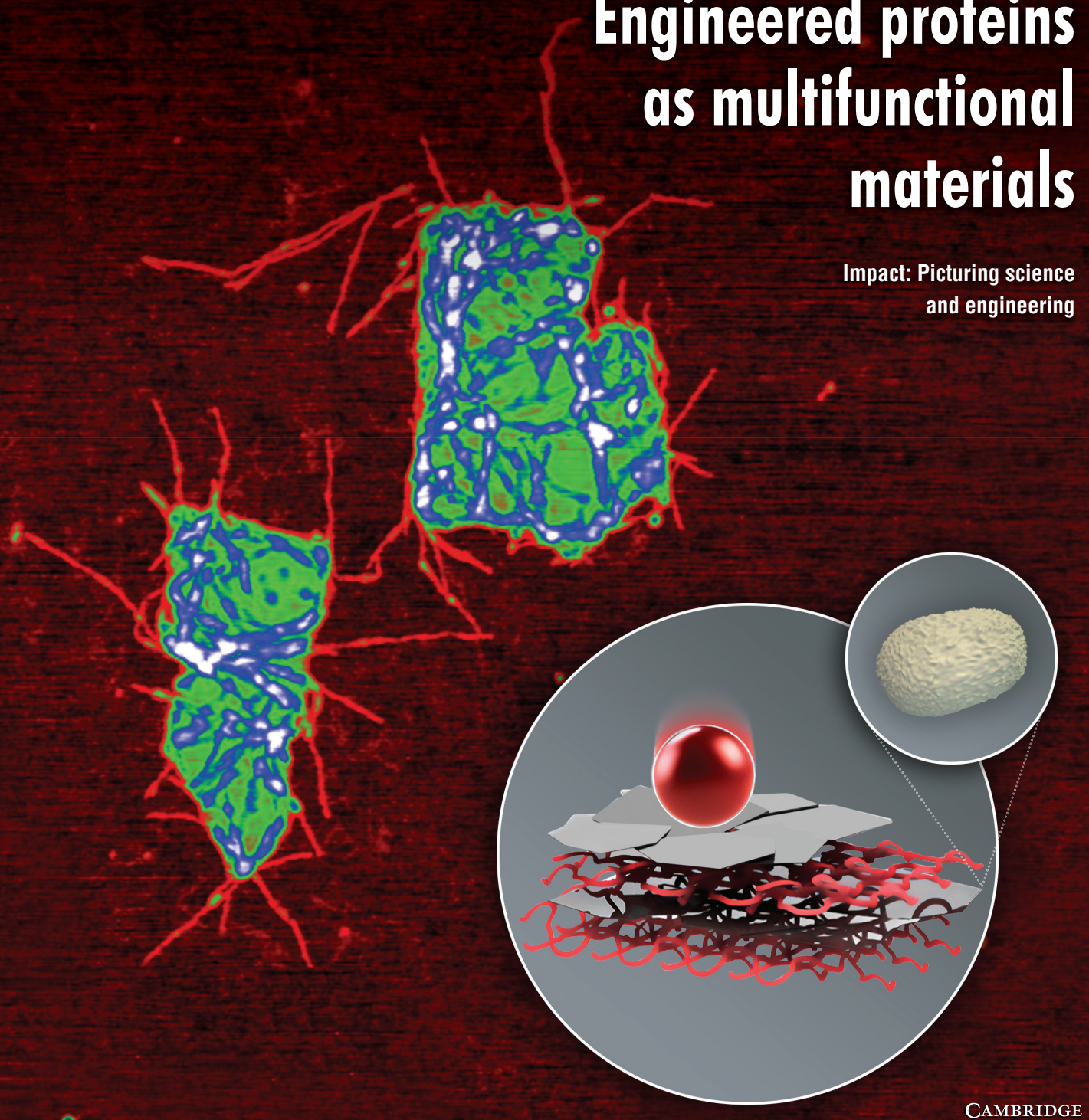


**MRS** MATERIALS RESEARCH SOCIETY®  
Advancing materials. Improving the quality of life.

December 2020 Vol. 45 No. 12  
mrs.org/bulletin

## Engineered proteins as multifunctional materials

Impact: Picturing science  
and engineering



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# CALL FOR LATE NEWS

Late News Submission Opens  
January 4, 2021Late News Submission Closes  
February 1, 2021

Spring Meeting registrations include MRS Membership July 1, 2021 – June 30, 2022

MRS recognizes the global pandemic may have long-lasting effects on face-to-face meetings. We anticipate seeing you in Seattle, but be assured we will continue to comply with COVID-19 guidelines in 2021. Hybrid and Virtual Meeting options will be considered as needed. Submit your abstract for review by the deadline and we will be in touch with authors on a timely basis as we determine the best—and safest—path forward.

## BROADER IMPACT

BI01 Incorporating Sustainability into Materials Science Education, Training and Public Outreach

## CHARACTERIZATION AND MODELING

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CT03 Imaging Materials with X-Rays—Recent Advances with Synchrotron and Laboratory Sources

CT04 Predictive Synthesis and Decisive Characterization of Emerging Quantum Materials

CT05 Artificial Intelligence and Automation for Materials Design

CT06 From Quantum Mechanics to Materials Engineering—Recent Progress on the Development and Novel Applications of *Ab Initio* Methods in Materials Science

CT07 Excited-State Properties of Materials—Theory and Computation

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EL03 Emerging Ionic Semiconductors—Research and Applications

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EL05 Advanced Functional, Linear/Nonlinear and Quantum Materials for Metasurfaces, Metamaterials and Nanophotonics

EL06 Molecular and Colloidal Plasmonics—Synthesis and Applications

EL07 Bioelectronics—Fundamentals and Applications

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EN02 Sustainable Routes to Fuels and Commodity Chemicals Production via Electrochemical Methods

EN03 Intercalation Energy-Storage Materials and Systems for Beyond Li-Ion Batteries

EN04 Toward High Safety and High Energy Density—Solid-State Batteries

EN05 Materials Challenges and Opportunities in Concentrated Solar Power Technologies

EN06 Frontier Energy Sciences in Halide Perovskites

EN07 Thin-Film Compound Semiconductor Photovoltaics

EN08 Progress in Understanding Charge Transfer at Electrochemical Interfaces in Batteries

EN09 Advances in Conversion Electrodes for Reliable Electrochemical Energy Storage

EN10 Transformation, Reaction and Organization at Functional Interfaces for Sustainable Energy Systems and Environmental Managements

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NM02 Superconducting Materials and Applications

NM03 Topological and Quantum Phenomena in Intermetallic Compounds and Heterostructures

NM04 Magnetic Skyrmions and Topological Effects in Materials and Nanostructures

NM05 Functional Nanoparticle Materials—Synthesis, Property and Applications

NM06 Manipulation and Detection of Physical Properties of Two-Dimensional Quantum Materials

NM07 Beyond Graphene 2D Materials—Synthesis, Properties and Device Applications

NM08 Nanoscale Heat Transport—Fundamentals

NM09 Nanogenerators and Piezotronics

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### *Multifunctional Materials from Design to Applications*

SM05 Progress in Multimaterials and Multiphase-Based Multifunctional Materials

SM06 Materials and Fabrication Schemes for Robotics

SM07 Building Advanced Materials by Self-Assembly

SM08 Next-Generation Materials and Technologies for 3D Printing and Bioprinting

SM09 Peptide and Protein Design for Responsive Materials

### *Sustainable Systems/Processes*

SM10 Progress in Green Chemistry Approaches for Sustainable Polymer Materials

SM11 Design and Analysis of Bioderived and Bioinspired Multifunctional Materials

SM12 Bioinspired Macromolecular Assembly and Hybrid Materials—From Fundamental Science to Applications

SM13 Advances in Membrane and Water Treatment Materials for Sustainable Environmental Remediation

## STRUCTURAL MATERIALS

ST01 Mechanical Behavior at Micro/Nanoscale

ST02 *In Situ* Mechanical Testing of Materials at Small Length Scales, Modeling and Data Analysis

ST03 Design, Synthesis and Characterization of Architected Materials for Structural Applications

ST04 High-Entropy Materials—From Fundamentals to Potential Applications

ST05 Mechanics of Energy-Storage Materials

## FOLLOW THE MEETING!

#S21MRS  **MRS MATERIALS RESEARCH SOCIETY®**  
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## Don't Miss These Future MRS Meetings!

2021 MRS Fall Meeting &amp; Exhibit

November 28–December 3, 2021, Boston, Massachusetts

2022 MRS Spring Meeting &amp; Exhibit

May 8–13, 2022, Honolulu, Hawaii

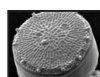
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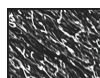
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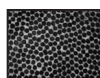
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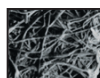
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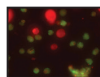
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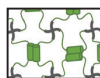
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**Engineered proteins as multifunctional materials.** Living organisms have engineered remarkable protein-based materials through billions of years of evolution. As multifunctional materials, these show unparalleled mechanical, optical, and electronic properties and have served as inspiration for scientists to study and mimic. This issue of *MRS Bulletin* covers the mechanical and rheological properties of engineered structural protein materials and nanocomposites, advancements in the synthesis and assembly of protein materials, and recent developments in the processing of these materials. The work in the inset on the

cover demonstrates that the specific penetration energy of a silk/graphene oxide bionanocomposite is significantly higher than that of Kevlar because of the nanoscale morphology and the interactions between the two components. The layer-by-layer bionanocomposite image depicts its brick and mortar structure and an approaching silica sphere in a projectile impact test. Image courtesy of Washington University in St. Louis. The background shows an atomic force microscope image of co-assembled silk and MXene flakes (Z-scale: 20 nm). The false color shows the silk corona morphology. Image courtesy of Michelle Krecker. See the technical theme that begins on p. 999.



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## About the Materials Research Society

The Materials Research Society (MRS), a not-for-profit scientific association founded in 1973 and headquartered in Warrendale, Pennsylvania, USA, promotes interdisciplinary materials research. Today, MRS is a growing, vibrant, member-driven organization of more than 14,000 materials researchers spanning over 80 countries, from academia, industry, and government, and a recognized leader in the advancement of interdisciplinary materials research.

The Society's interdisciplinary approach differs from that of single-discipline professional societies because it promotes information exchange across many scientific and technical fields touching materials development. MRS conducts three major international annual meetings and also sponsors numerous single-topic scientific meetings. The Society recognizes professional and technical excellence and fosters technical interaction through University Chapters. In the international arena, MRS implements bilateral projects with partner organizations to benefit the worldwide materials community. The Materials Research Society Foundation helps the Society advance its mission by supporting various projects and initiatives.

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