Journal of Dynamic Behavior of Materials: A New Forum for Knowledge Exchange on Dynamic Material Response, High Strain-Rate Effects, Shock, and Materials Under Extreme Loading

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We are excited to introduce the *Journal of Dynamic Behavior of Materials* (JDBM) as the new journal of the Society for Experimental Mechanics (SEM). We wish to invite you to submit your best work on the study of the dynamic behavior of materials to the journal and help in getting the word out to your colleagues. Information on the journal can be found at <http://springer.com/40870>.

The field of dynamic behavior of materials is undergoing a revolution with increasing interdisciplinary focus and unprecedented new level of diagnosis at the bench scale and numerous user facilities. Classic loading techniques including split Hopkinson pressure (Kolsky) bar, gas/powder guns, and high-explosives are being pushed to increased levels of precision, linked with new and novel diagnostics enabling previously unattainable levels of in situ measurement combined with advanced high resolution and three-dimensional post-mortem observation. National User Facilities are enhancing their capacities for studying materials in extremes with new facilities being developed ranging from SLAC's Linac Coherent Light Source, the Dynamic Compression Sector at the Advanced Photon Source at Argonne National Laboratory, the Z-Machine at Sandia National Laboratories, the National Ignition Facility at Lawrence Livermore National Laboratory, and Matter-Radiation Interactions in Extremes at Los Alamos National Laboratory. An exciting collaboration at GSI in Darmstadt is incorporating expertise from pRad and LANSCE at Los Alamos National Laboratory in the USA and the Institute for Theoretical and Experimental Physics in Russia using the PRIOR microscope with great potential for studying dynamic materials processes. The Diamond

Light Source located at the Harwell Science and Innovation Campus in the UK has been offering great levels of post-mortem investigation of damage from dynamic loading. Exciting capabilities exist at these and other facilities around the world to advance the state-of-the-art for studies of dynamic behavior of materials.

Advances in modeling & simulation of dynamic loading and material response have paralleled these experimental advances. Continued evolution in computing hardware is enabling calculations with extraordinary fidelity in representation of highly coupled complex physics. Great advances have been made in density functional theory, molecular dynamics, and dislocation dynamics based material models. Simulations based on these theories have historically had to be performed at very high strain-rates and in very short time and length scales. Advances in these models and the hardware on which these simulations are performed have brought them into line with the regimes of many platforms for dynamic experiments. New theories and models of material behavior are being developed to take advantage of understanding material at the meso-scale. Continuum level constitutive models are being proposed and developed with greater levels of physical underpinning and predictive ability. The state-of-the art in modeling & simulation and experiments along with the interdisciplinary approach to modern science and engineering have lead to significant payoff from hybrid experimental-computational approaches. Advances in simulation are enabling the development and optimization of experiments, with better understanding of the underlying physics and data capture. Conversely, advances in experimentation are pushing better models, codes, and simulations.

The JDBM offers a single source to bring this broad, vibrant international community together. This peer

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reviewed, archival journal, published by SEM and Springer, will address the science and engineering of material and structural response to dynamic loading focused on high strain-rate, impact, blast, penetration, and shock response. The JDBM publishes experimental, theoretical, modeling and simulation, and interdisciplinary work focused both on advancement of new techniques and application of techniques to new materials and structures. All dynamic deformation processes characterized by a large strain and strain rate larger than 1 s^{-1} are encouraged. In general work on small strains, vibration, fatigue, or modal analysis is outside of the scope of this journal. Experimental material characterization techniques include, but are not limited to, small-scale experiments for constitutive response of material such as split Hopkinson pressure bar or Kolsky bar, shock loading utilizing gas guns, lasers, explosives, or magnetic techniques, and drop tower. Other relevant techniques include small-scale integrated tests for validation of material constitutive models such as Taylor Anvil, Dynamic-Tensile-Extrusion, high-explosive driven perturbed plate experiments, shock tube loading and integrated structure level experiments (e.g. blast, impact, crash, and penetration mechanics). The JDBM also covers diagnostics for dynamic experiments to include, but not be limited to, full-field high-speed imaging of transient deformation, pressure, and temperature fields with optical, radiographic, digital image correlation, and fluorescence methods; and sensors such as velocimetry, strain gages, contact pins, force transducers, thermal couples, pressure gages, etc. The JDBM will also include research focused on application of modeling techniques such as molecular dynamics, density functional theory, and dislocation dynamics as well as continuum or multi-scale approaches applied to problems and regimes outlined above. In addition to primary research articles, JDBM publishes review articles, brief technical notes, and applications articles that discuss important emerging technologies.

Over the past decade SEM and the Journal Experimental Mechanics have seen a dramatic increase in the focus on the science and engineering of dynamic behavior of materials. The SEM has a long and rich history of advancing the split Hopkinson pressure bar or Kolsky bar techniques for the study of high strain-rate material response. To address the growing technical community SEM formed a Technical Division on Dynamic Behavior of Materials in 2005. The SEM has been publishing an annual series of conference proceedings of the work presented within the Dynamic Behavior of Materials Technical Division. This has grown to encompass a wide range of dynamic experimental techniques and address materials response questions far beyond its roots in the split Hopkinson pressure bar or Kolsky bar techniques. The Journal Experimental Mechanics has seen broad growth in the past

decade with an increase from four issues to the current nine issues per year. In recent years several Special Issues of Experimental Mechanics have focused on dynamic behavior of materials in addition to individual papers contributed to the journal on this topic. Against that backdrop, the SEM Executive Director Dr. Thomas Proulx posed a question in 2013: Does the international community studying dynamic behavior of materials have a focused journal serving our field? That question led to efforts over the past year polling members of the broader international scientific and engineering community across many societies and conferences that address various aspects of the dynamic behavior of materials. The answer we resoundingly heard was that while there are many journals that will publish work on dynamic behavior as part of their portfolio, there was no single journal that focused exclusively on dynamic behavior of materials. Moreover, many authors found that they would have to choose between journals focusing on the materials science and engineering or dynamic loading aspects of their work. Many journals exist with a rich history of advancing materials science and engineering in terms of chemistry, physics, manufacturing, and deformation in the quasi-static regime but do not offer a robust review and understanding of the unique and challenging aspects of dynamic loading. Conversely, a number of journals exist that focus on the physics and mechanics of dynamic loading but do not embrace the importance and elegance of the resulting mechanisms driving material response. The new JDBM is the outcome of the past year's collaboration among many members of the dynamic behavior of materials community, SEM, and our publishing partner Springer. The JDBM seeks to fill this gap, serving authors who desire rigorous peer review of both the materials science and engineering and dynamic loading aspects of their work.

Please enjoy this inaugural issue of JDBM. We thank you for your interest and sincerely invite you to submit your significant research papers to JDBM. We welcome suggestions for improvements to the journal as it grows. With the strength of the ever-growing dynamic behavior of materials science research community, we are confident that JDBM will prove to be a great success with your support and contributions.

This first issue includes two studies of the tensile response of individual fibers under dynamic loading including in situ observations of fiber failure at the Advanced Photon Source, constitutive modeling of selected polymers over a wide range of strain rates, use of polyurea to mitigate acceleration of dynamically loaded structures, and the electro-mechanical behavior of graphene-polystyrene composites. It also presents technique development for dynamic loading including a three-bar Kolsky apparatus for high-rate three-point flexure, a new hydraulic crash

machine for composite structures, a novel splitting-beam laser extensometer for Kolsky tension bar, and accounting for bending in an optically instrumented miniature Kolsky bar. This diverse group of international submissions represents an introduction to just some of the many areas JDBM seeks to encompass, with more exciting papers in the pipeline for future issues of this quarterly journal.

The cover image is a series of proton radiographs of disks (left to right, top to bottom) of aluminum, copper, tantalum, and tin that have been explosively shocked from below. The radiographs reveal the internal structure of the materials in these extreme conditions. For example, the aluminum sample shows the formation of layers of spall while the tin sample displays characteristics of melting. These images are provided courtesy of Dr. David Holtkamp and the Los Alamos National Laboratory Proton Radiography Team.

This first issue and the new journal would not have been possible without the tremendous support of the SEM Board of Directors and staff, the JDBM Editorial Board and International Board, and broad input from this technical community. I am grateful to the support and input of all. Most importantly, JDBM would not exist without the vision and drive of SEM's Executive Director, Dr. Thomas W. Proulx. Tom passed away suddenly in Oct, 2014 shortly after JDBM launched its first call for submissions and the journal received its first submission. He was very proud and posted the email from the first submission at SEM

headquarters. I wish to recognize the immeasurable contributions Tom Proulx made to the launch of JDBM, to SEM in his role as Executive Director from 2001 to 2014, and to me personally as a friend, colleague, and mentor. The future growth and success of JDBM will be a part of Tom's enduring legacy to the community. This first issue of the JDBM is dedicated to Dr. Thomas William Proulx (June 3, 1948 to October 21, 2014).

Editor-in-Chief Dr. Eric N. Brown

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