THE MATERIALS SCIENCE AND ENGINEERING DEPARTMENT SPRING COLLOQUIUM SERIES PRESENTS:

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Controlled spalling of wafer-scale, single-crystal films of high-quality, high-value semiconductors

Controlled spalling is a method to produce thin, continuous single-crystal films at semiconductor wafer scale. This fracture-based technique offers promise for dramatically lowering substrate cost for high-efficiency III-V solar cells. Spalling fracture has been engineered to controllably and intentionally exfoliate thin film electronic devices from single-crystal semiconductors for the purposes of creating flexible devices or enabling substrate reuse to mitigate costs. The process uses an adhered stressor layer combined with an externally applied mechanical force to initiate and propagate a lateral fracture parallel to the substrate surface. Devices have been successfully removed from silicon, gallium arsenide, germanium, and gallium nitride substrates using this method. In this talk, examples will be drawn mainly from spalling (100)-oriented Ge and GaAs to illustrate the impact of cleavage system alignment on the resulting fracture morphology and spalling conditions. The spontaneous spalling model of Suo & Hutchinson has been used to model behavior in these systems, approximating spall depth and critical spalling conditions reasonably well. Fractography, surface analysis, and spatially resolved device performance characterization are used to understand the impact of morphological defects in spalled surfaces on device performance.

Dr. Packard is an Associate Professor in the George S. Ansell Metallurgical and Materials Engineering Department at the Colorado School of Mines and holds a joint appointment at the National Renewable Energy Laboratory (NREL). She is the co-director of the International Center for Multiscale Characterization, a network of experts and state- of-the-art instruments at Mines and NREL that enable materials characterization and cross-correlation with functional properties and performance from the atomic- to macro-scales. Prior to appointment at Mines, Packard earned her Ph.D. in Materials Science & Engineering from MIT. Her research program applies experimental techniques commonly used to characterize mechanical behavior and properties in structural materials to solve problems in ceramics in predominantly energy-related applications. She has focused on elucidating the principles and mechanisms of deformation behavior in ceramics at the micro- and nano-scales. In 2014, she received a National Science Foundation Faculty Early Career Development (CAREER) Award and was selected as a TMS Young Leader. In 2017, she received the AIME Robert Lansing Hardy Award. Last year, she received the Colorado School of Mines Faculty Excellence Award. To date, she has more than 40 archival publications, 3 issued patents, and has given over 40 invited and contributed talks.

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