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**George E. Duvall Shock Compression Science Award Talk: Developing a Pathway to Microstructure-Aware Predictive Capability for the Dynamic Response of Materials**

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It is sixty years since Cyril Stanley Smith's seminal paper describing the effects of shock loading on the structure / property behavior of metals. While numerous experimental observations have fostered the correlation of post-shock microstructural parameters, such as dislocations, point defects, deformation twins, shock-induced phase products, etc., with particular shock parameters, quantitative predictive capability of the defect generation and damage evolution in materials subjected to dynamic loading has yet to be realized. Broadly based defect generation/storage phenomenology presenting a unified view of the material structure/property aspects of shock-wave deformation for a wide range of crystal structures has proven very difficult. However, changes in design and manufacturing paradigms applied to events dominated by dynamic-loading processes have placed increased emphasis on developing physically-based predictive materials models of shock effects on materials. In this talk, a survey of the state-of-our-understanding of defect generation and damage evolution will be discussed and thoughts on the evolving capabilities to move dynamic behavior of materials research from observation to design and control will be presented.