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The Quest for Greater Chemical Energy Storage: A Deceiving Game of Nanometer Manipulation

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It is well known that modern energetic materials based on organic chemistry have nearly reached a plateau in performance with only $\sim 40\%$ improvement realized over the past half century. This fact has stimulated research on alternative chemical energy storage schema in various US government funded "High Energy Density Materials" (HEDM) programs since the 1950's. These efforts have examined a wide range of phenomena such as free radical stabilization, metallic hydrogen, metastable helium, polynitrogens, extended molecular solids, nanothermites, and others. In spite of the substantial research investments, significant improvements in energetic material performance have not been forthcoming. In this talk we will survey various fundamental modes of chemical energy storage, lesson's learned in the various HEDM programs, and areas that are being explored currently. A recurring theme in all of this work is the challenge to successfully manipulate and stabilize matter at the ~ 1 nm scale.