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Seminar

Watching solids and liquids through the ultrafast shock compression microscope

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We have developed a microscope that looks into solids and liquids as they are subjected to controlled high velocity impacts from laser-launched flyer plates. This convenient tabletop microscope set up allows us to perform well-characterized controlled shock experiments on tiny samples hundreds of shots per day. The flyer plates move a few kilometers per second, creating intense mechanical and thermal effects that can trigger new kinds of chemistry. One of these impacts can create pressures of 200,000 atm and temperatures of 4000K while compressing matter to half its density. In this talk, I will describe the shock compression microscope and the peripheral high-speed optical diagnostics that measure pressure, temperature, density and composition in real time. I will mention applications ongoing in my lab, such as metal-organic frameworks as shock energy absorbers, proteins under shock compression and molecular photophysics in shock-compressed matter. Then I will discuss shock initiation and detonation of high explosives, including liquid explosives and plastic-bonded explosives. This shock compression microscope has many applications in chemistry, physics, materials science and biology and it lets us see right inside detonating high explosives with high time and space resolution.

Dana Dlott is the William H. and Janet G. Lycan Emeritus Professor of Chemistry and a Professor of Materials Research at the University of Illinois. He received a bachelor's degree from Columbia University and a Ph.D. from Stanford University under the supervision of Prof. Michael Fayer, using ultrafast laser spectroscopy to study electronic energy transfer in molecular materials. After he joined the Chemistry Department at the University of Illinois (in 1979) he began a research program to study vibrational relaxation in solids. About 30 years ago he began to study shock waves in solids. Dlott is a Fellow of the American Physical Society, the Optical Society of America and the American Association for the Advancement of Science. He has been recognized with the ACS award in Experimental Physical Chemistry and the Lippincott prize of the OSA for his work in ultrafast vibrational spectroscopy. He is a former Chair of the APS Topical Group on Shock Compression in Condensed Matter and the author of 325 scientific publications.

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