

Investigating ultrafast structural changes of warm dense matter –connecting atomistic details with transport properties

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When driven to extreme temperatures, solid density matter can exhibit properties different than those found at ambient conditions. Measurement of properties, in particular transport properties such as the electrical conductivity, has been possible by heating thin films of material using ultrafast lasers. However, interpretation of experimental results and comparison with theoretical prediction requires knowledge of the atomic arrangement and phase of the material. Here, we use MeV-UED to study the structural evolution of Al heated to extreme temperatures. The Al films show rapid melting on an ~ 3 ps timescale, with the measurements indicating that the atoms retain a solid-like structure for the first ps after heating. We combine these results with ultrafast conductivity measurements to correlate the change in the lattice structure as the material melts.

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