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Ultrafast probing of the x-ray-induced lattice and electron dynamics in graphite at atomic-resolution

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Proposal number: L123
Proposal Title: Ultrafast probing of the x-ray-induced lattice and electron dynamics in graphite at atomic-resolution
Date of experiment: 7/1 to 7/4, 2010
Instrument used: AMO/CAMP

Brief summary:

We used LCLS pulses to study ultrafast x-ray-induced transitions of graphite from solid to liquid and plasma states. This was accomplished by isochoric heating of graphite samples and simultaneous probing via Bragg and diffuse scattering at high time resolution. We observed that disintegration of the crystal lattice and ion heating of up to 5 eV occurred within tens of femtoseconds. The threshold fluence for Bragg-peak degradation was smaller and the ion-heating rate was faster than current x-ray-matter interaction models predicted.

Successful: Yes

Dissemination of the results:

1.) Journal papers:

- S.P. Hau-Riege, A. Graf, T. Döppner, R. A. London, J. Krzywinski, C. Fortmann, S. H. Glenzer, M. Frank, K. Sokolowski-Tinten, M. Messerschmidt, C. Bostedt, S. Schorb, J. A. Bradley, A. Lutman, D. Rolles, A. Rudenko, B. Rudek, Ultrafast transitions from solid to liquid and plasma states of graphite induced by x-ray free-electron laser pulses, *Phys. Rev. Lett.* **108**, 217402 (2012).
- T. Döppner, S.P. Hau-Riege, A. Graf, R. A. London, J. Krzywinski, C. Fortmann, S. H. Glenzer, M. Frank, K. Sokolowski-Tinten, M. Messerschmidt, C. Bostedt, S. Schorb, J. A. Bradley, A. Lutman, D. Rolles, A. Rudenko, B. Rudek, Using inelastic scattering to probe to solid-plasma transition in graphite, to be submitted.

2.) Conference presentations:

- S.P. Hau-Riege, International Workshop on Science with XFELs 2012, Ringberg Castle, Germany (invited). S.P. Hau-Riege, 2012 ARAMIS Instrumentation Workshop, Paul Scherrer Institut, Villingen, Switzerland (invited).
- S.P. Hau-Riege, 2011 International Workshop on Warm Dense Matter, Pacific Grove, CA (invited).
- S.P. Hau-Riege 2010 X-Ray Science in the 21th Century, Kavli Institute, Santa Barbara (invited).
- S.P. Hau-Riege, 2010 Gordon Research Conference on Multiphoton Processes (invited).
- S.P. Hau-Riege, International Workshop on Science with XFELs 2010, Ringberg Castle, Germany (invited).

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