Abstract Submitted
for the SHOCK07 Meeting of
The American Physical Society

Phase transformation and spall fracture in laser shock-loaded iron
THIBAUT DE RESSEGUIER, MARTINE HALLOUIN, CNRS, LCD TEAM — Despite extensive research work on the $\alpha - \varepsilon$ phase transition occurring in shock-loaded iron, the kinetics of this transformation remain largely unknown. Here, we present time-resolved free surface velocity measurements in iron foils of thicknesses ranging from 150 to 500 μm subjected to laser shocks of peak pressure about 100 GPa and duration about 5 ns. The records clearly show an elastic precursor followed by a plastic front, but the double wave structure usually associated with the phase change does not appear clearly over such short propagation distances. The measured profiles are compared with the predictions of one-dimensional simulations involving time-dependent descriptions of both twinning and phase transition. Such comparisons provide an estimate of a time constant governing the transformation kinetics, which is found to strongly condition the attenuation of the pressure pulse during its propagation. They also allow testing the predictive capability of simple spall models. Metallurgical observations of the recovered samples confirm both the phase transition and the spall damage inferred from the velocity profiles. Finally, they show the very clear change of fracture surface morphology to the so-called smooth spall expected above the phase transformation.

Thibaut De Resseguier
CNRS

Date submitted: 22 Feb 2007 Electronic form version 1.4