Abstract Submitted
for the MAR05 Meeting of
The American Physical Society

Continuum Theory of Dislocations: Cell Structure Formation SURACHATE LIMKUMNERD, The Laboratory of Atomic and Solid State Physics, Cornell University, JAMES P. SETHNA, The Laboratory of Atomic and Solid State Physics, Cornell University — Line-like topological defects inside metals are called dislocations. These dislocations in late stages of hardening form patterns called *cell structures*. We are developing a mesoscale theory for the formation of cell structures that systematically derives the order parameter fields and evolution laws from the conserved topological Burgers vector density or the Nye dislocation tensor. (In classical plasticity theories, describing scales large compared to these cells, one normally bypasses the complicated motions of the dislocations by supplying yield surface and plastic hardening function in order to determine the evolution of state variables.) Using Landau approach and a closure approximation, an evolution equation for the dislocation density tensor is obtained by employing simple symmetry arguments and the constraint that the elastic energy must decrease with time at fixed stress. The evolution laws lead to singularity formation at finite times, which we expect will be related to the formation of cell walls. Implementation of finite difference simulations using the upwind scheme and the results in one and higher dimensions will be discussed.

Surachate Limkumnerd
The Laboratory of Atomic and Solid State Physics, Cornell University

Date submitted: 30 Nov 2004 Electronic form version 1.4