Atom probe analysis of interfaces in pearlite

Y. Li, S. Goto, C. Borchers*, P. Choi, M. Herbig, S. Zaefferer, A. Kostka, J. von Pezold, A. Nematollahi, J. Neugebauer, R. Kirchheim*, D. Raabe

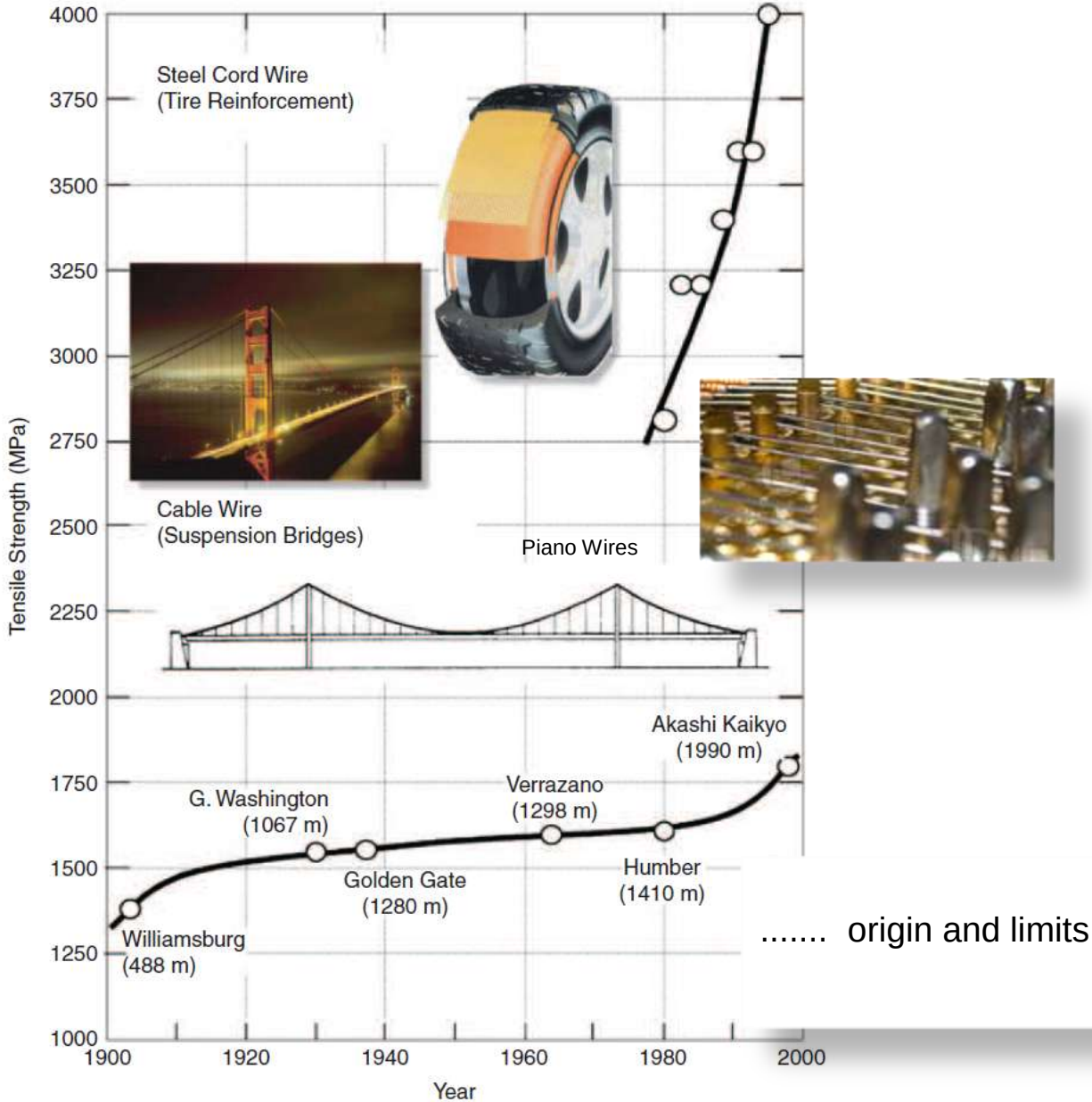
*** Institut für Materialphysik, Georg-August-Universität Göttingen, Germany**

Max-Planck-Institut
für Eisenforschung GmbH
Düsseldorf, Germany
WWW.MPIE.DE
d.raabe@mpie.de

Overview

- Motivation: Pearlite is the strongest mass-produced bulk structural material
- Joint chemical and structure analysis of interfaces
- Pearlite nanostructures
- Conclusions

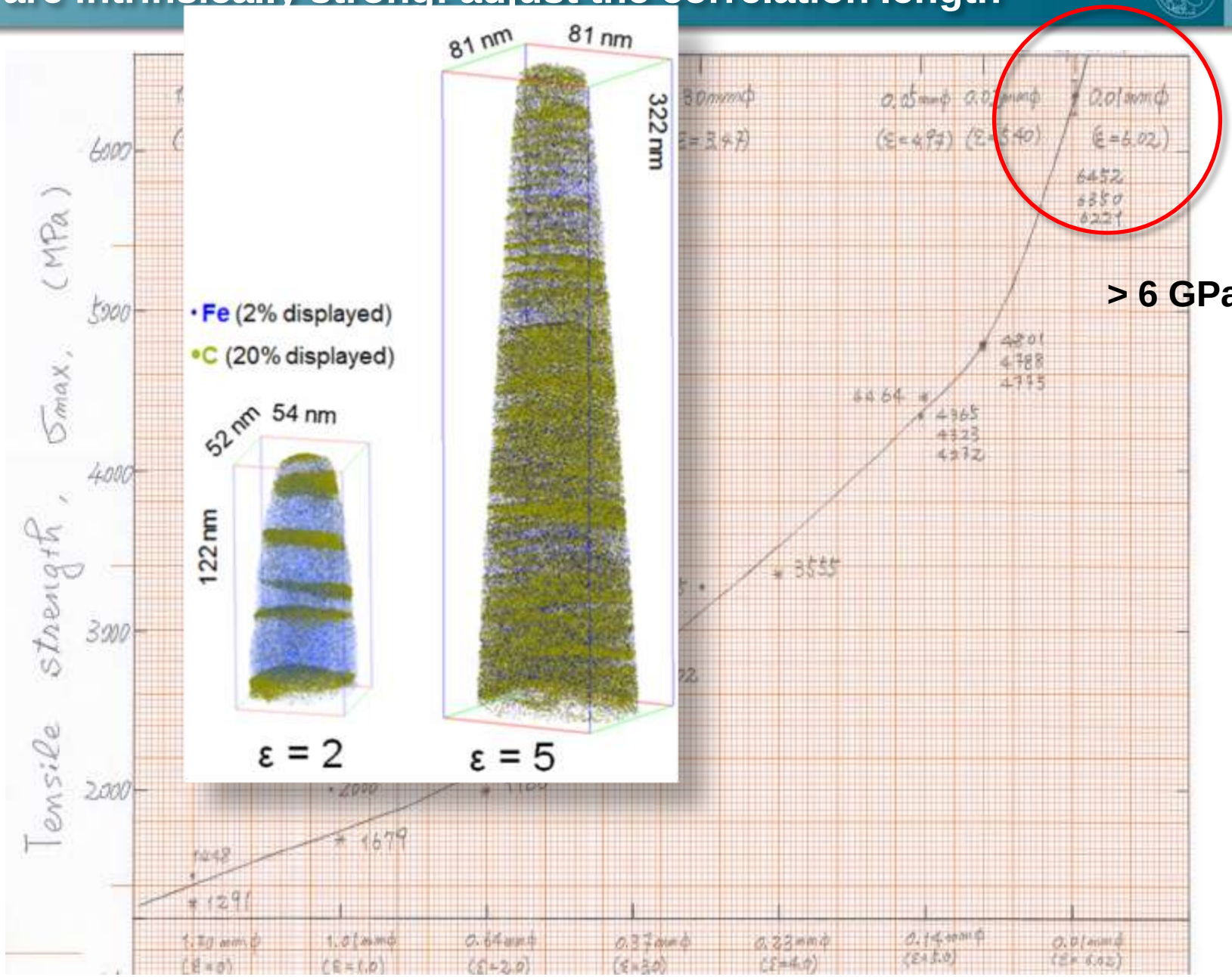
Pearlite is the strongest mass-produced bulk structural material



..... origin and limits of strength ?

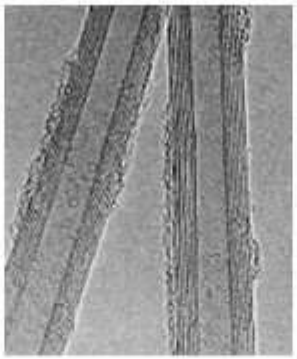
Li et al.: Acta Mater. 59 (2011) 3965

Steels are intrinsically strong: adjust the correlation length

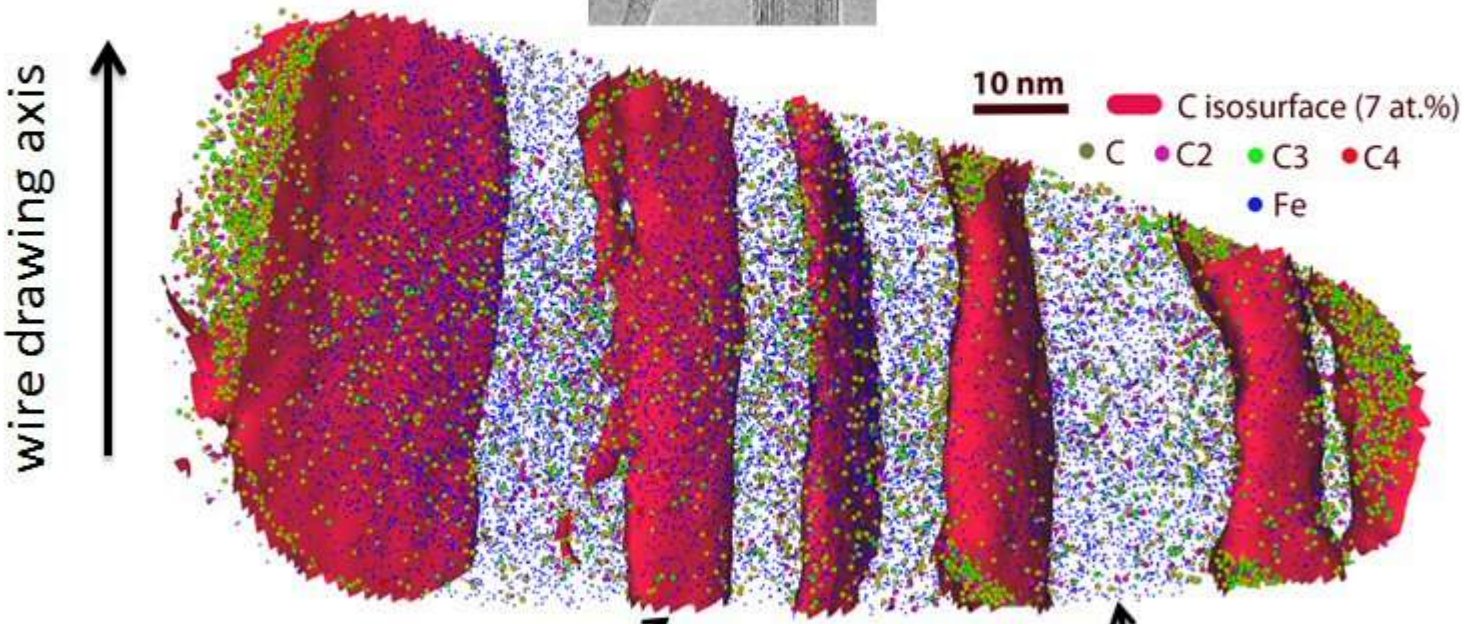


Li et al.: Acta Mater. 60 (2012) 4005

Pearlite has a structure correlation length below that of CNTs



carbon nanotube
as size reference
(same scale bar)



remaining
cementite after wire
heavy drawing

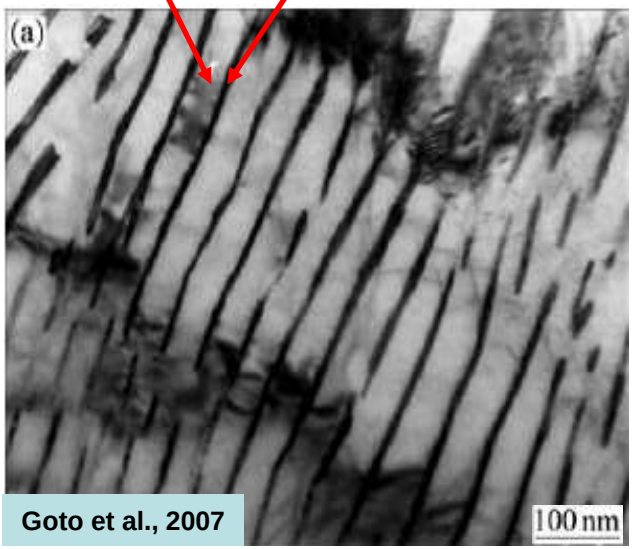
carbon-
enriched ferrite

Raabe et al.: MRS Bull. 35 (2010) 982

Cementite decomposition, C in ferrite, dislocations in ferrite

Pearlitic wire (0.7-1.2 wt.% C)

Ferrite (~50 ppm C) Cementite (25 at.% C) + **Severe plastic deformation (cold drawing)**

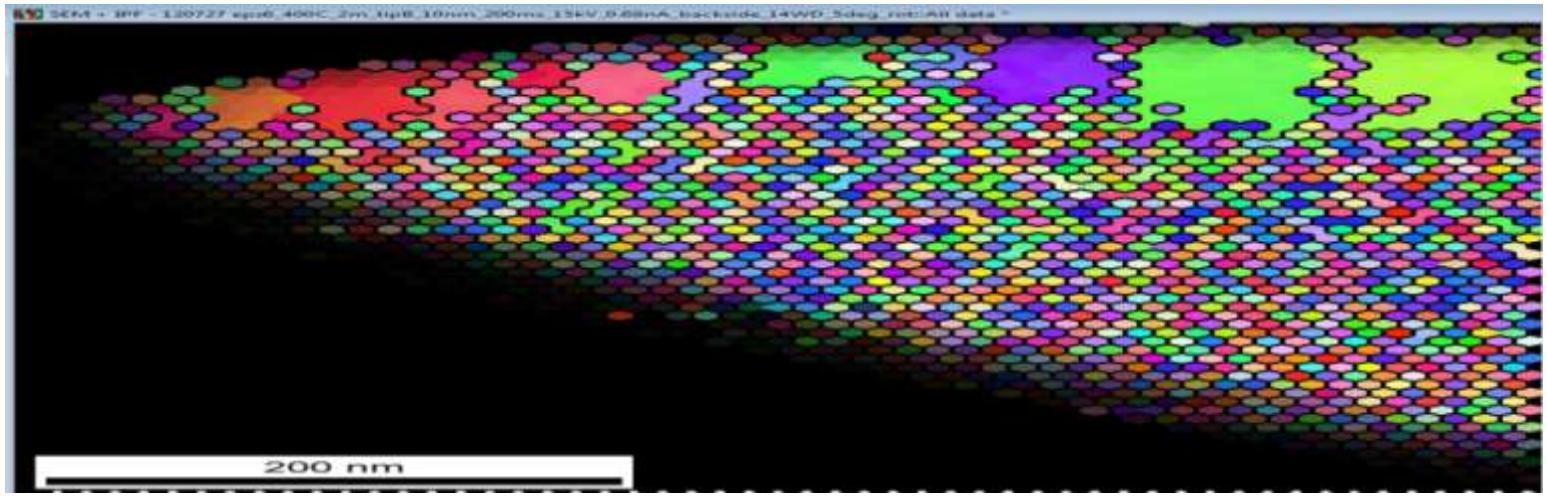


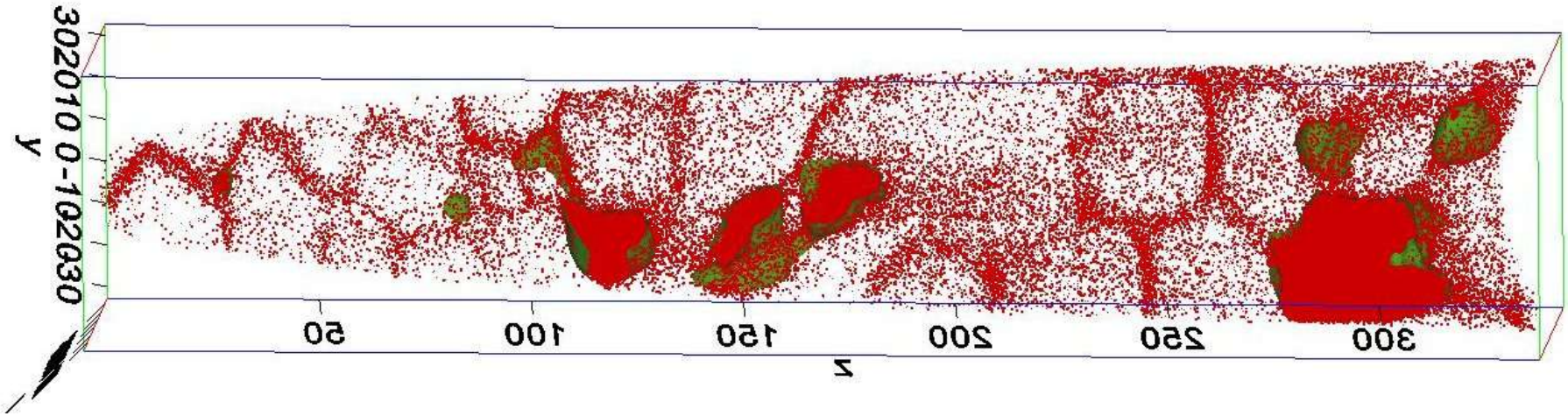
Goto et al., 2007

	C	Mn	Si	Cr	Cu	P	S
wt.%	0.98	0.31	0.20	0.20	0.01	0.006	0.007
at.%	4.40	0.30	0.39	0.21	0.003	0.01	0.01

Li et al.: Acta Mater. 60 (2012) 4005

Joint EBSD and APT analysis of APT pearlite tips





Pearlite, eps6.02, 400°C 2min

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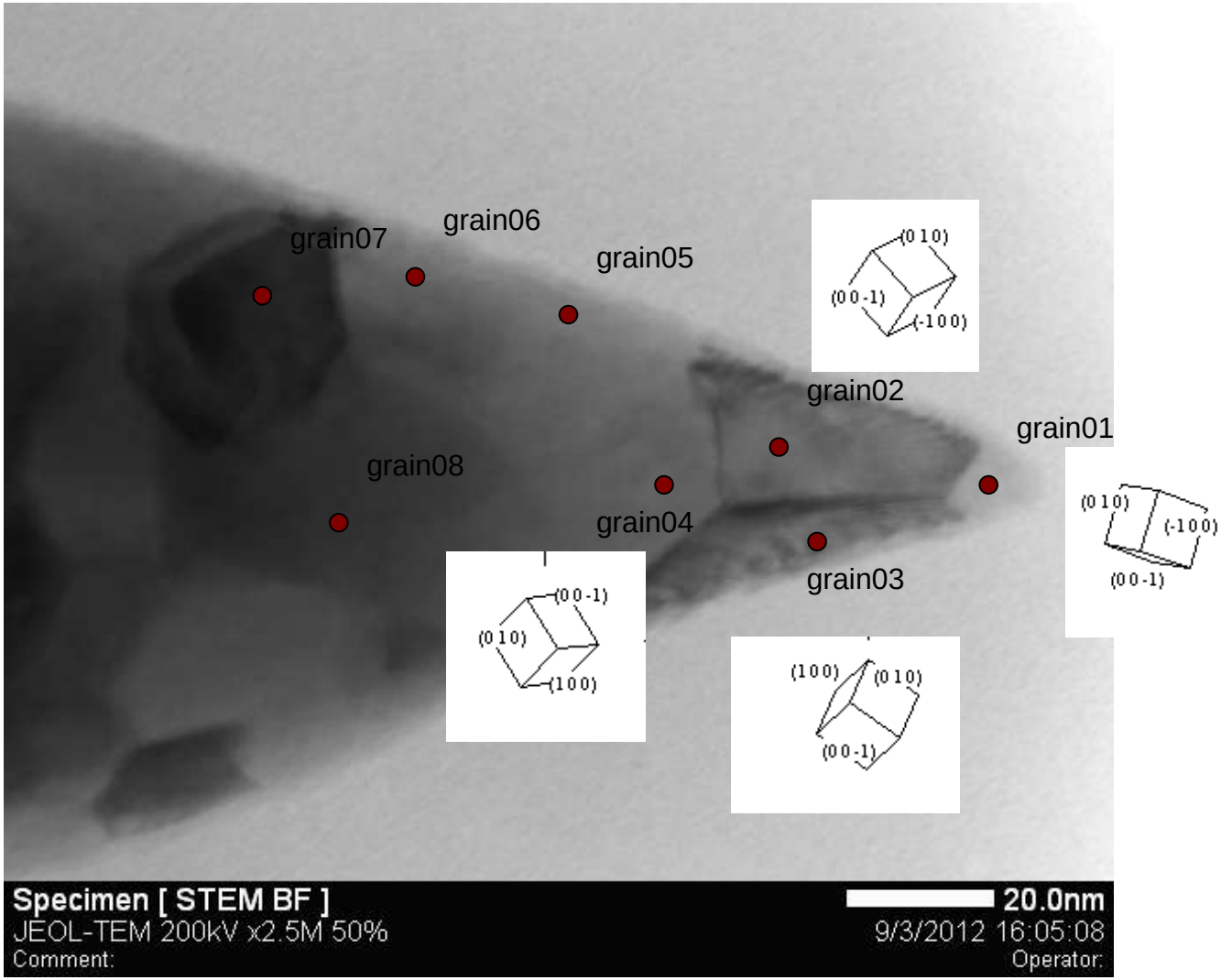
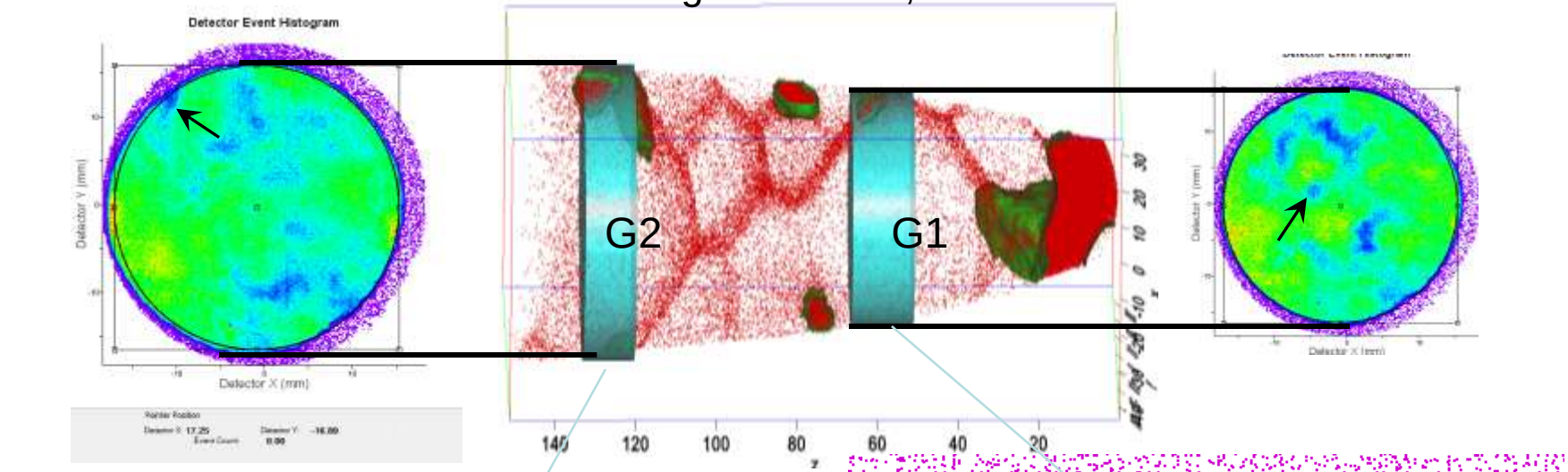
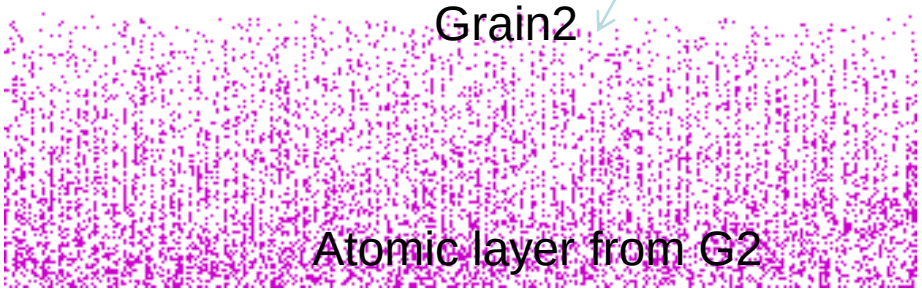
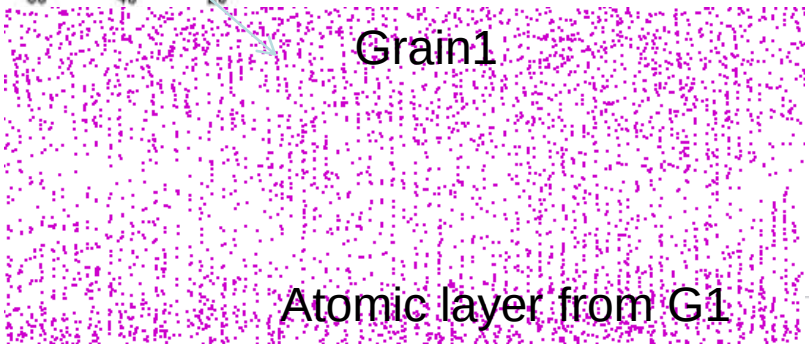
Joint TEM and APT analysis of APT pearlite tips

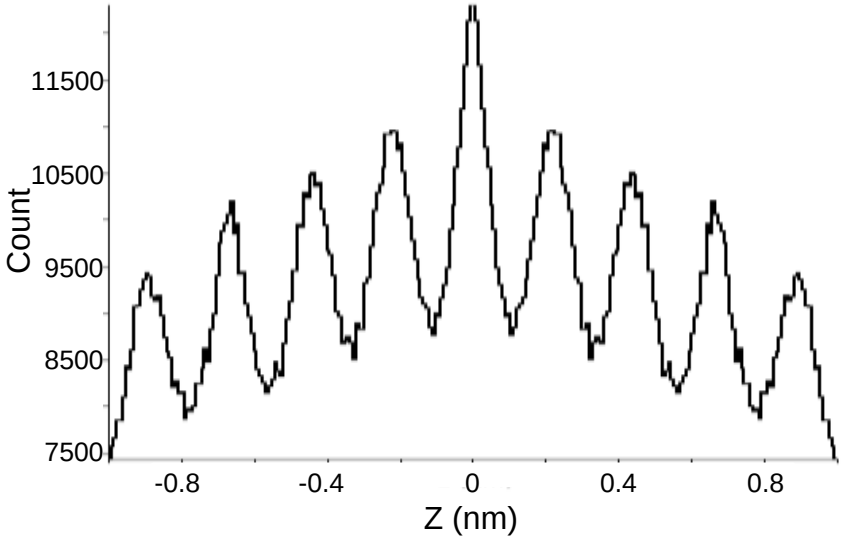


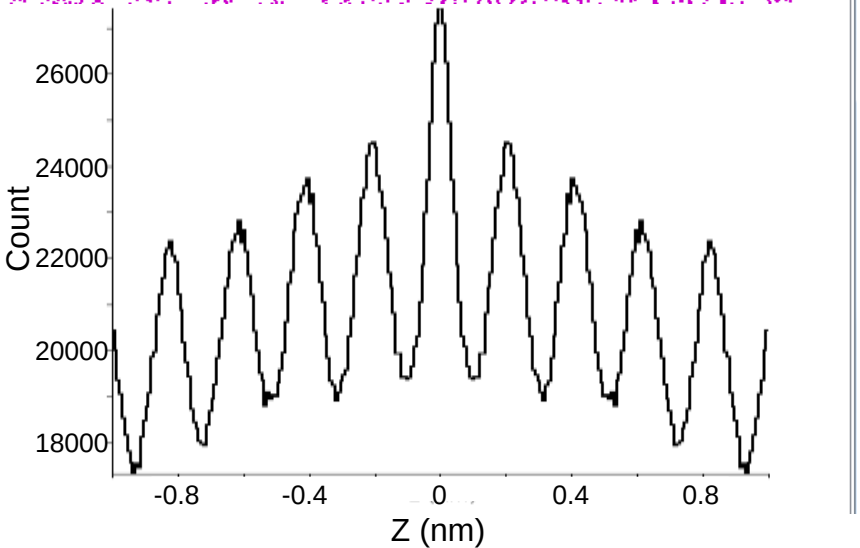
Drawing strain 6.02, annealed at 400 K for 30 min



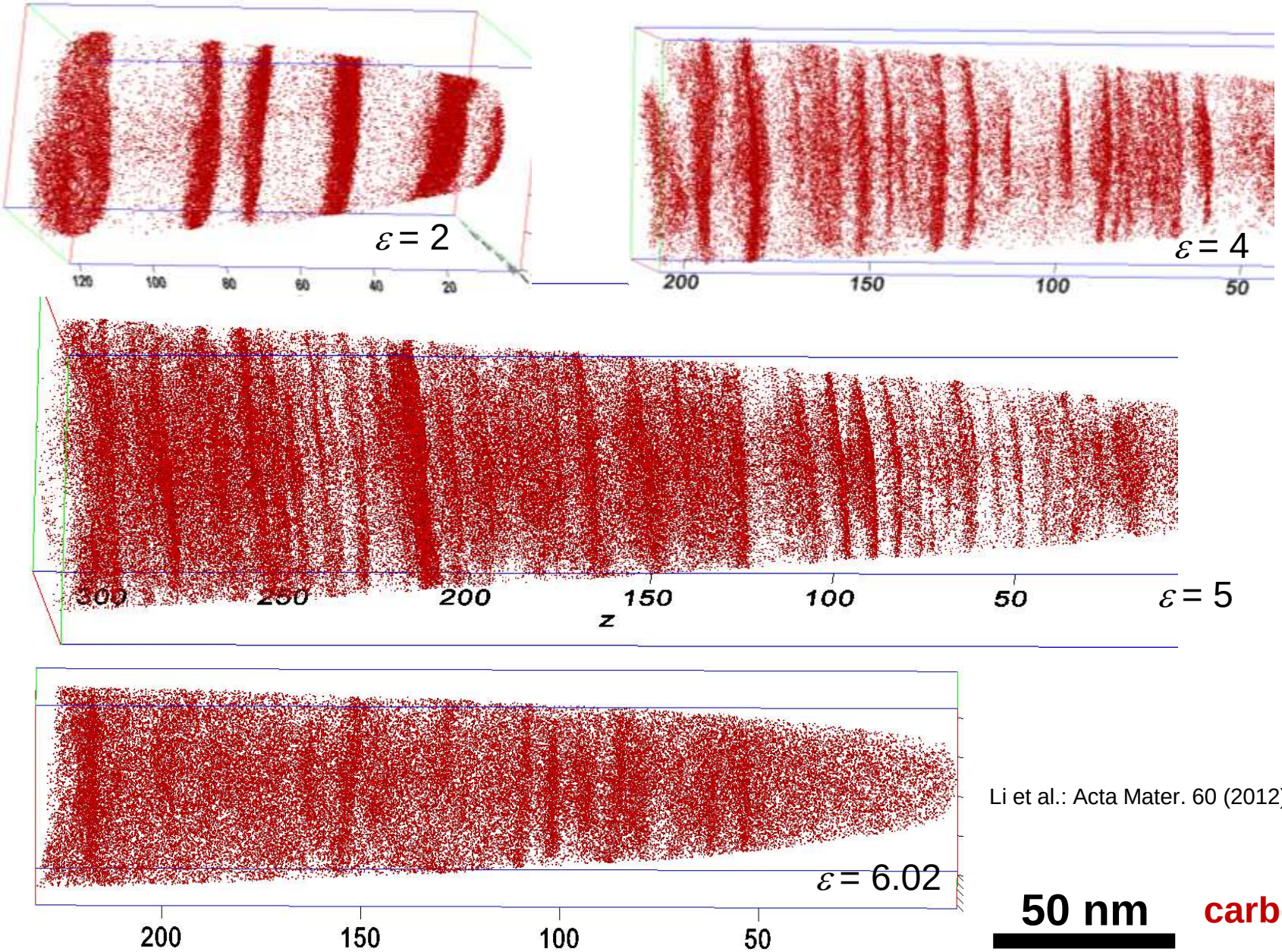








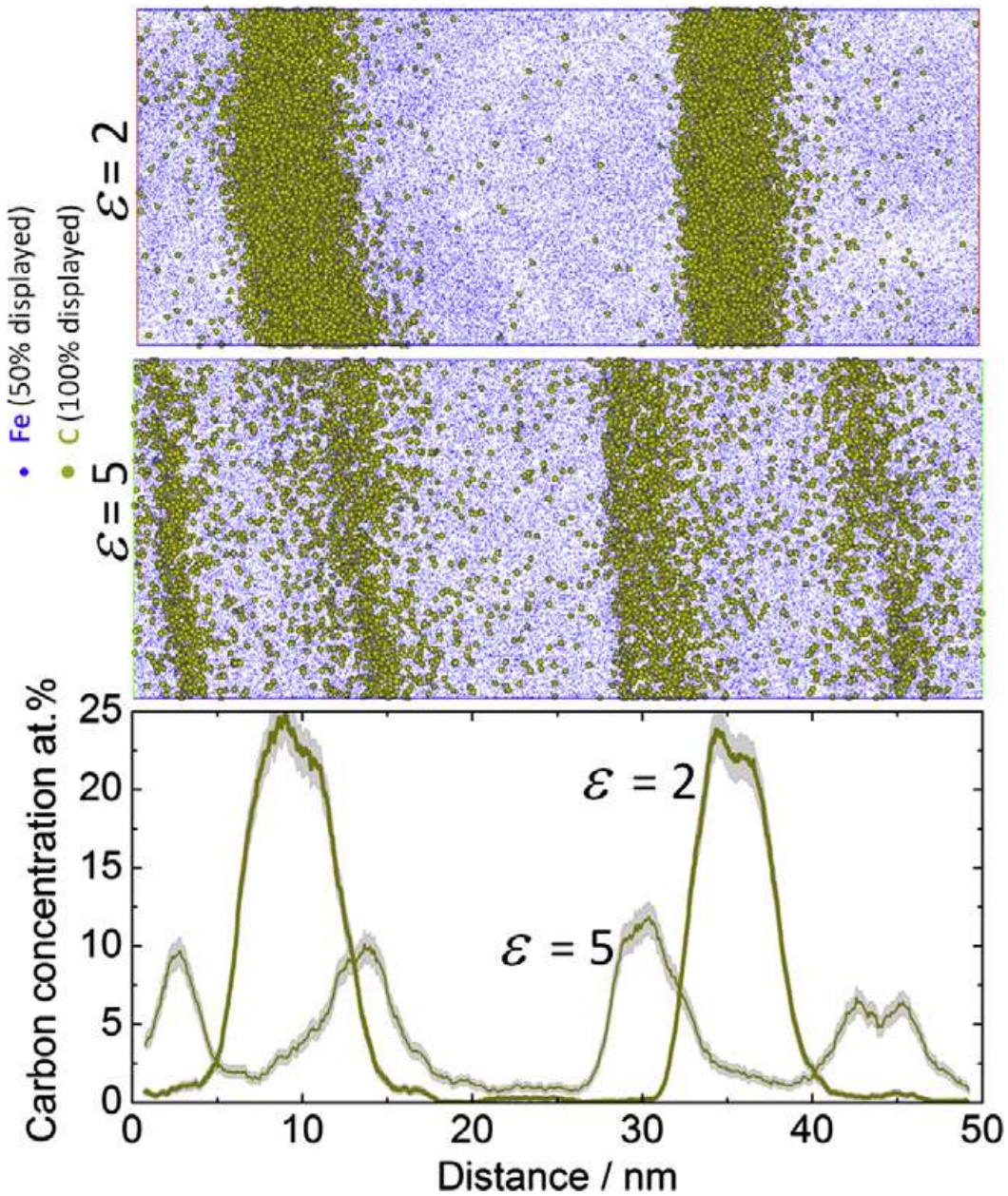
APT analysis of carbon distribution and carbide dissolution



Li et al.: Acta Mater. 60 (2012) 4005

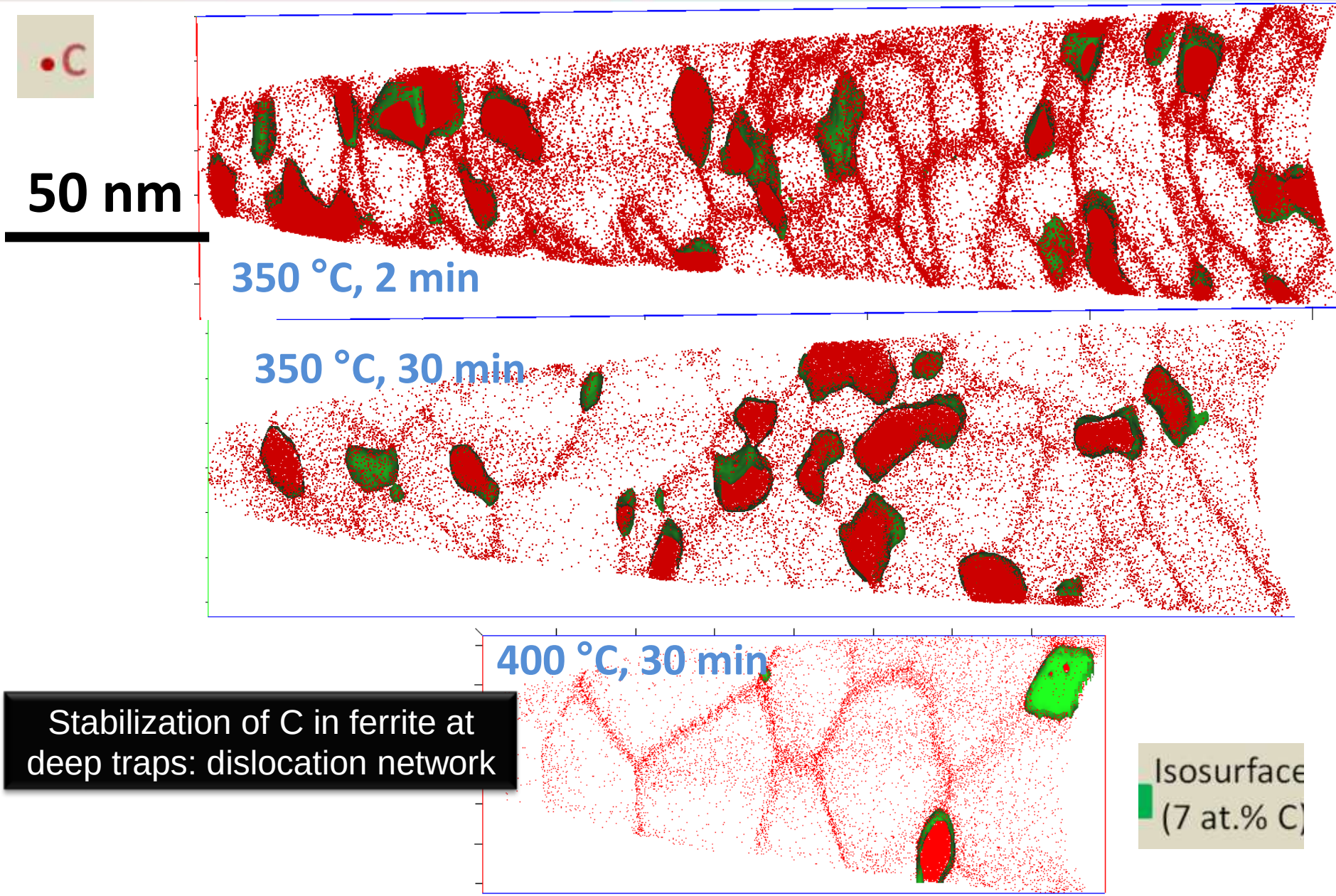
Raabe et al.: MRS Bull. 35 (2010) 982

How does the carbon get into the ferrite so massively ?



Raabe et al.: MRS Bull. 35 (2010) 982

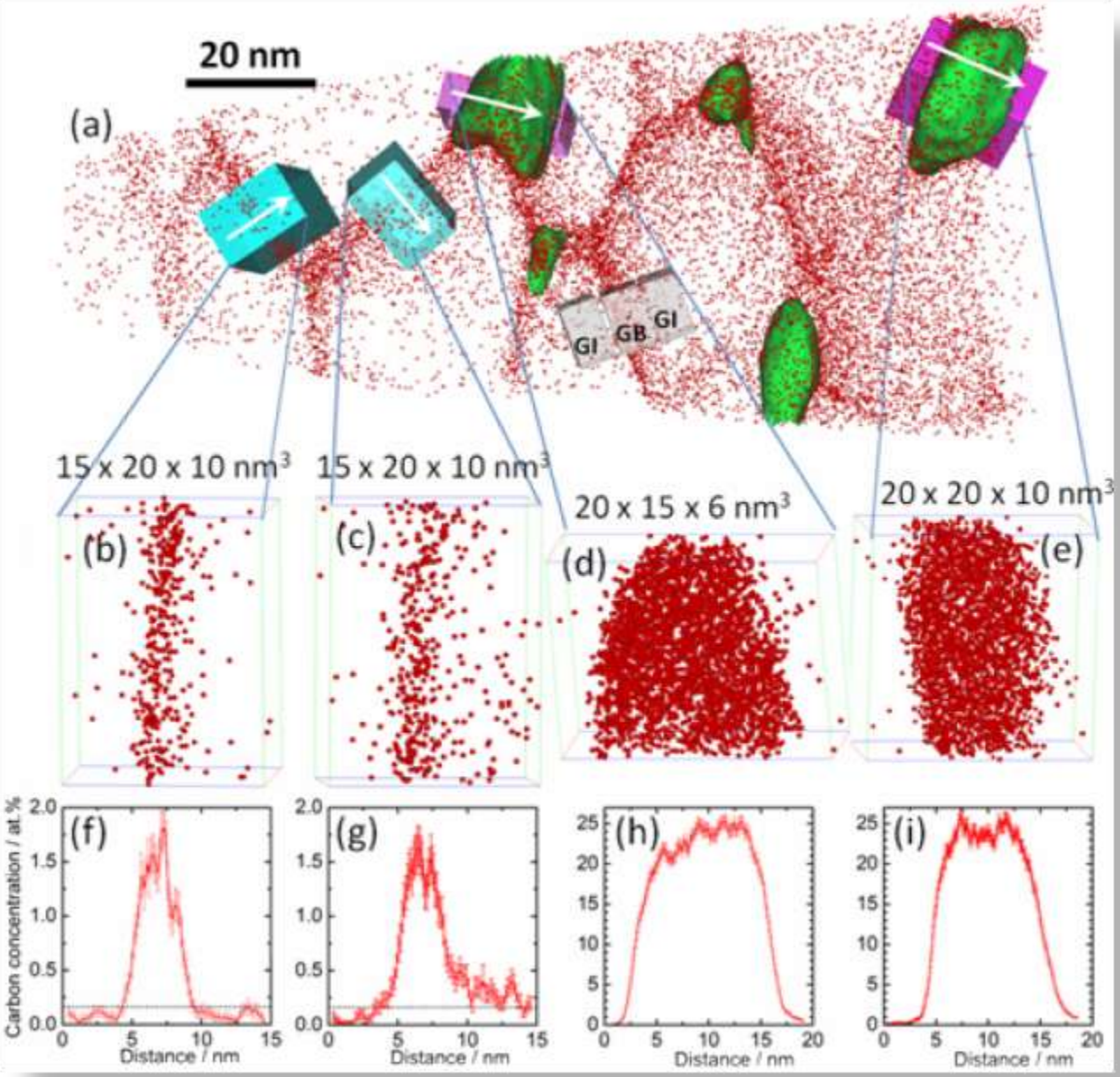
Heat treatment and segregation of C to substructure



Stabilization of C in ferrite at deep traps: dislocation network

Li et al.: Acta Mater. 60 (2012) 4005

Pearlite, 400°C, 30 min



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