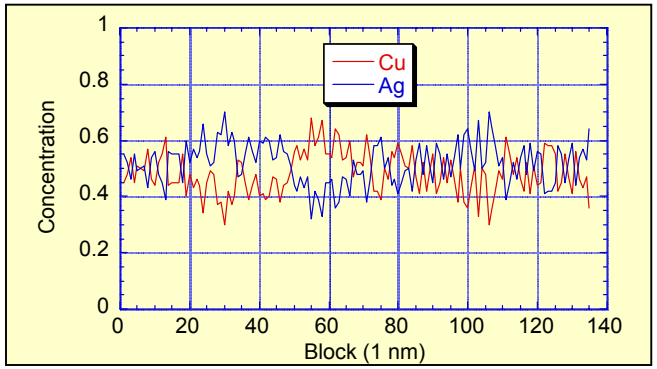
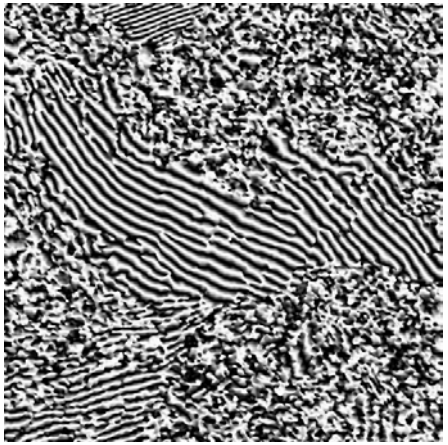
SYNTHESIS AND CHARACTERIZATION OF METALLIC NANOCOMPOSITES

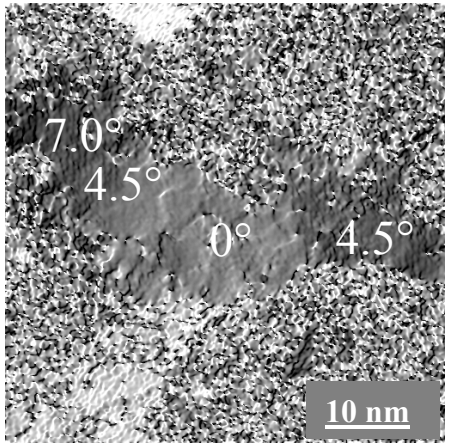
Pascal Bellon, University of Illinois, DMR Award# 97-33582

I/ Nanostructured Ag-Cu Solid Solutions stabilized by Low-Temperature Ball Milling

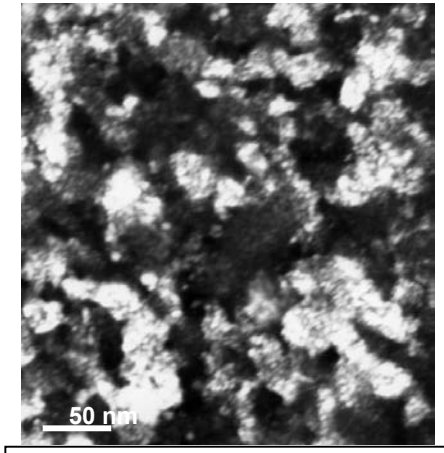


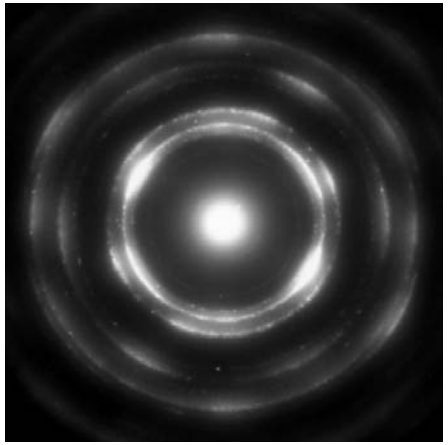
Atom Probe Field Ion Microscopy: random alloy synthesized by milling at LN2





HREM with geometric phase Image method:moiré image (left) and map of local lattice rotations (right)





Transmission Electron Microscopy: heavily textured microstructure with ≈ 100x30x30 nm^3 units

Complex multiscale microstructure:

- pronounced {110} texture
- high dislocation density $< \rho_d > \approx 10^{16}$ m^{-2}
- "grains" ≈ 100 x 30 x 30 nm^3
- "sub-grains" ≈ 10 nm in extension with rotations from 4° to 12°, with no or partial plastic accommodation

SYNTHESIS AND CHARACTERIZATION OF METALLIC NANOCOMPOSITES

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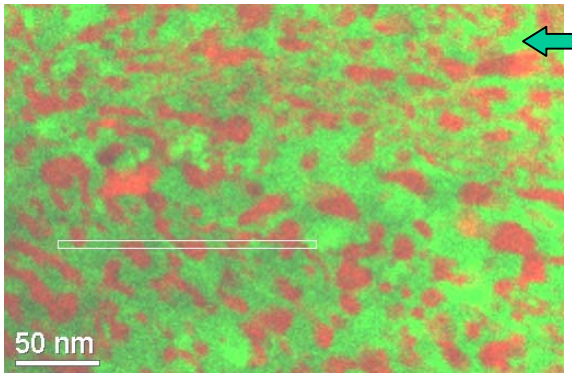
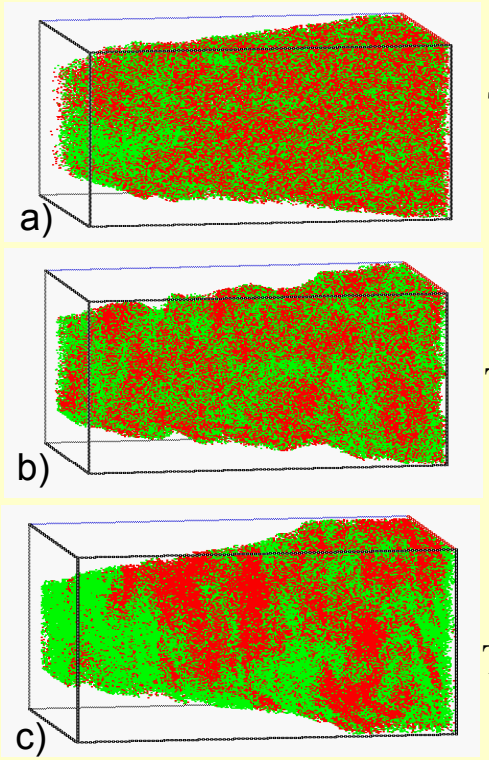
II/ Ag-Cu Nanocomposites Synthesized by Elevated-Temperature Ball Milling



STEM-EDS
3D-Atom Probe
(coll. D. Seidman, NU)
Cu Ag



T_{mill}=120˚C

T_{mill}=150˚C

T_{mill}=180˚C

Decomposition during milling, no recrystallization

Decomposition and dynamic recrystallization during milling at 230˚C

III/ Broader impact of the research

- trained 1 graduate student, 2 undergraduates, 1 research associate.

- introduced senior lab projects on nanomaterials.

- initiated collaborations to advance atom probe characterization of powder materials w/ Profs. A. J. Melmed (formerly JHU) and D. N. Seidman (NU), and to advance structural TEM characterization of complex nanomaterials w/ Dr. M. J. Hÿtch and Prof. J.-P. Chevalier (CNRS-France).

Direct synthesis of nanocomposites

- L ≤ 10 nm if recrystallization suppressed
- L ≈ 30-100 nm if recrystallization occurs
- nanohardness from 5 to 6 GPa