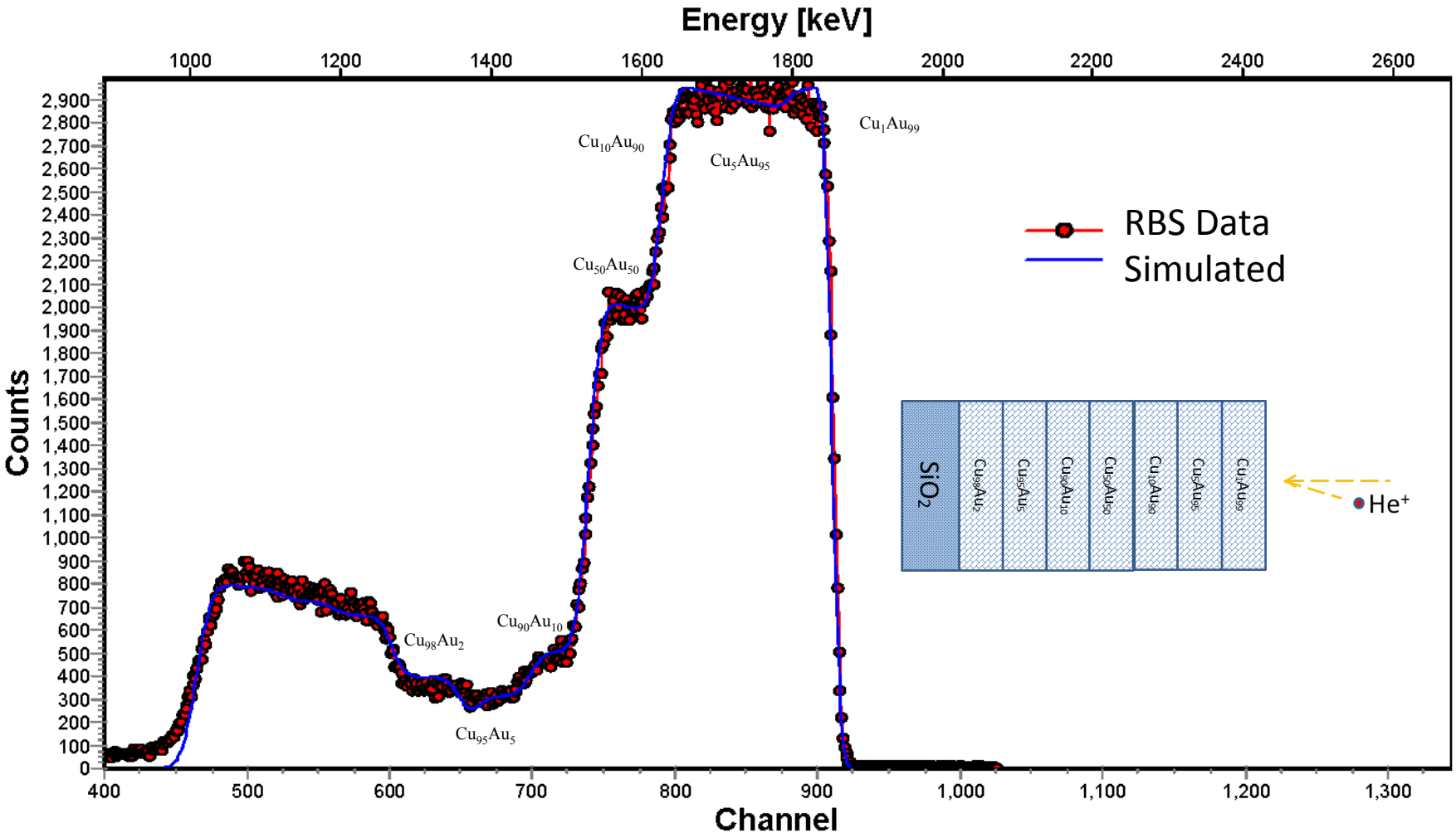
Secondary Ion Mass Spectrometry (SIMS)

In secondary ion mass spectrometry (SIMS) a focused ion beam is directed to a solid surface, removing material in the form of neutral and ionized atoms and molecules. The secondary ions are then accelerated into a mass spectrometer and separated according to their mass-to-charge ratio. This allows for sensitivity in parts per billion for many elements and can perform depth profiles with minimum 3 nm depth resolution.

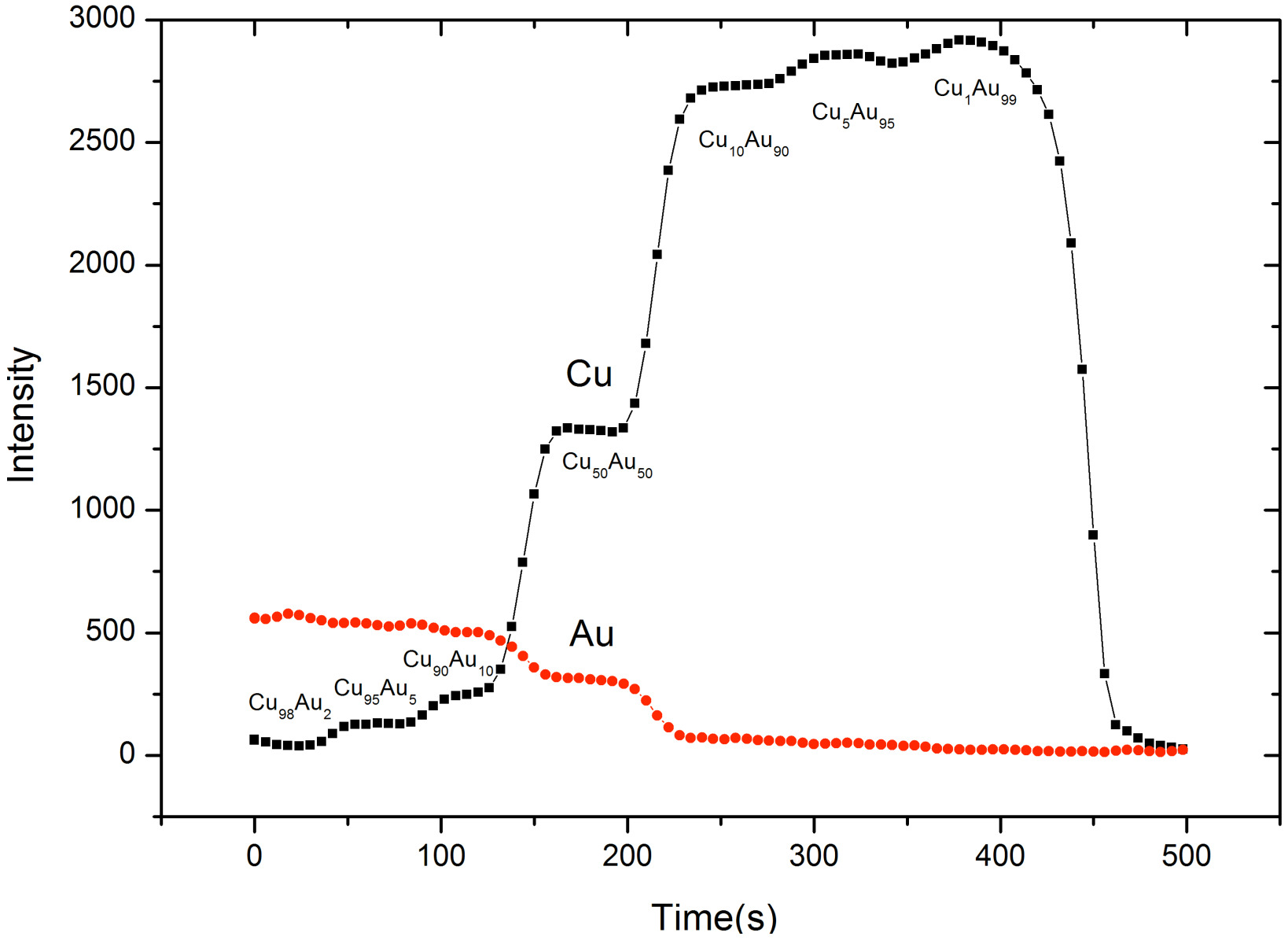
Main Problem: "Matrix Effect"

SIMS Raw Data is Count Numbers-Time and strongly depends on Chemical Environment.

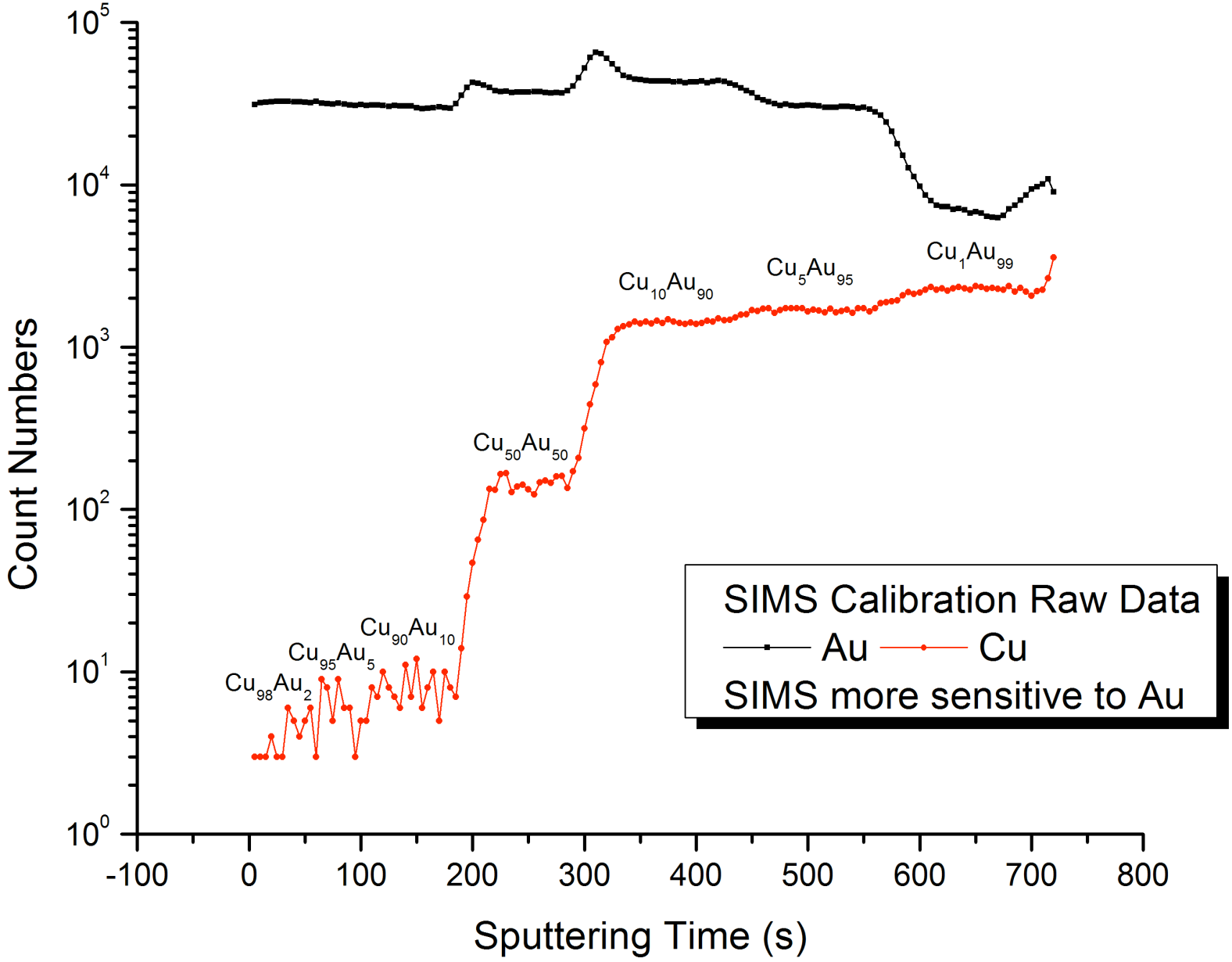
No "real concentration" is directly available. (i.e. needs calibration)



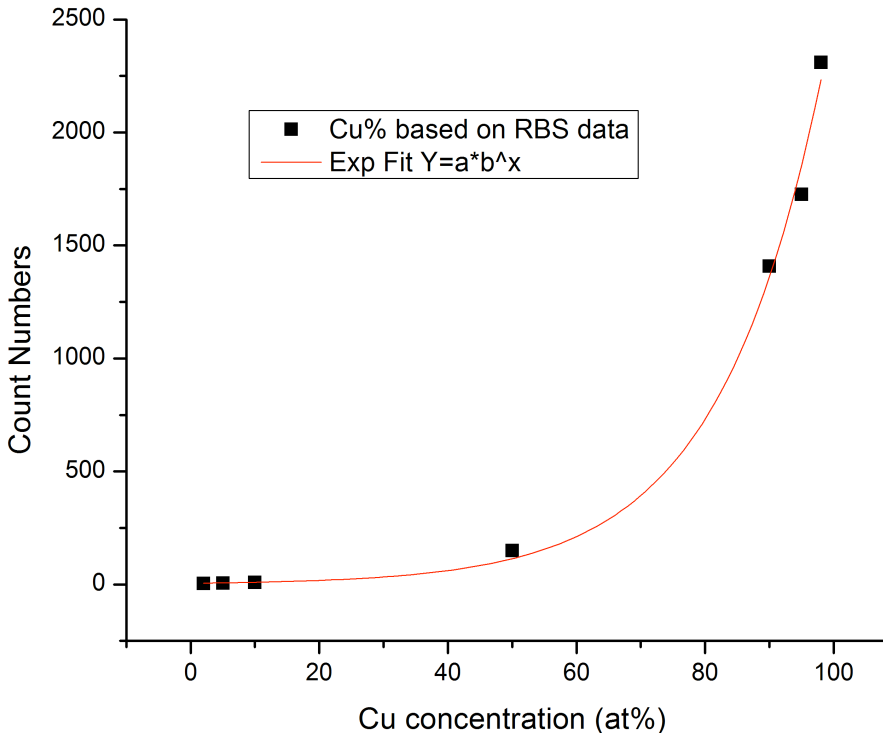
7 Multilayers Determined by RBS to Calibrate SIMS “Matrix Effect”

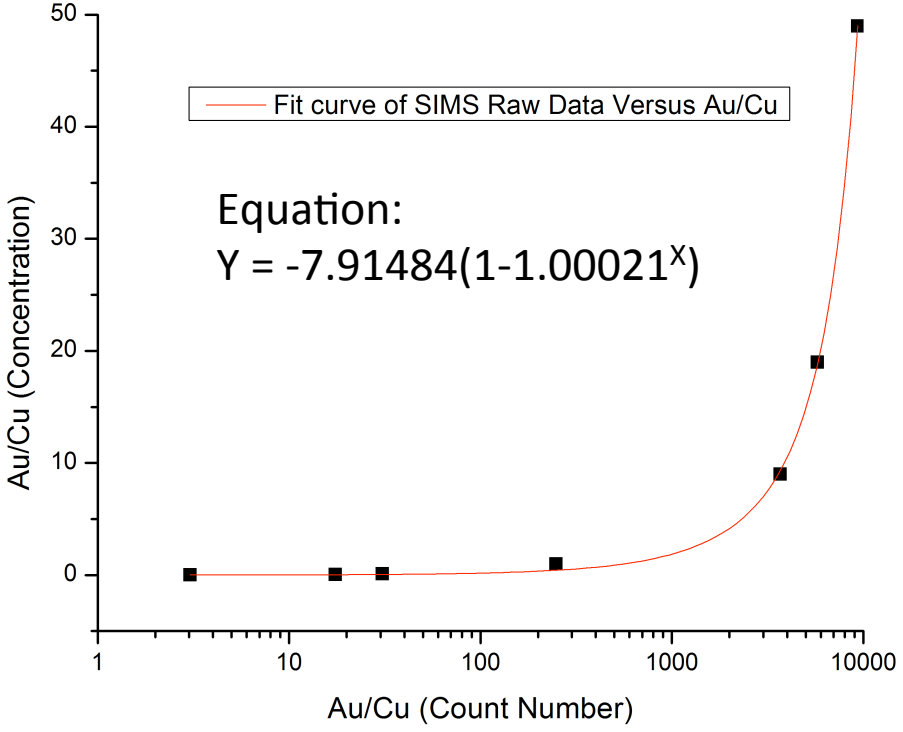


7 Multilayers Confirmed by AES (more sensitive to Cu)



7 Multilayers Determined by SIMS (more sensitive to Au)

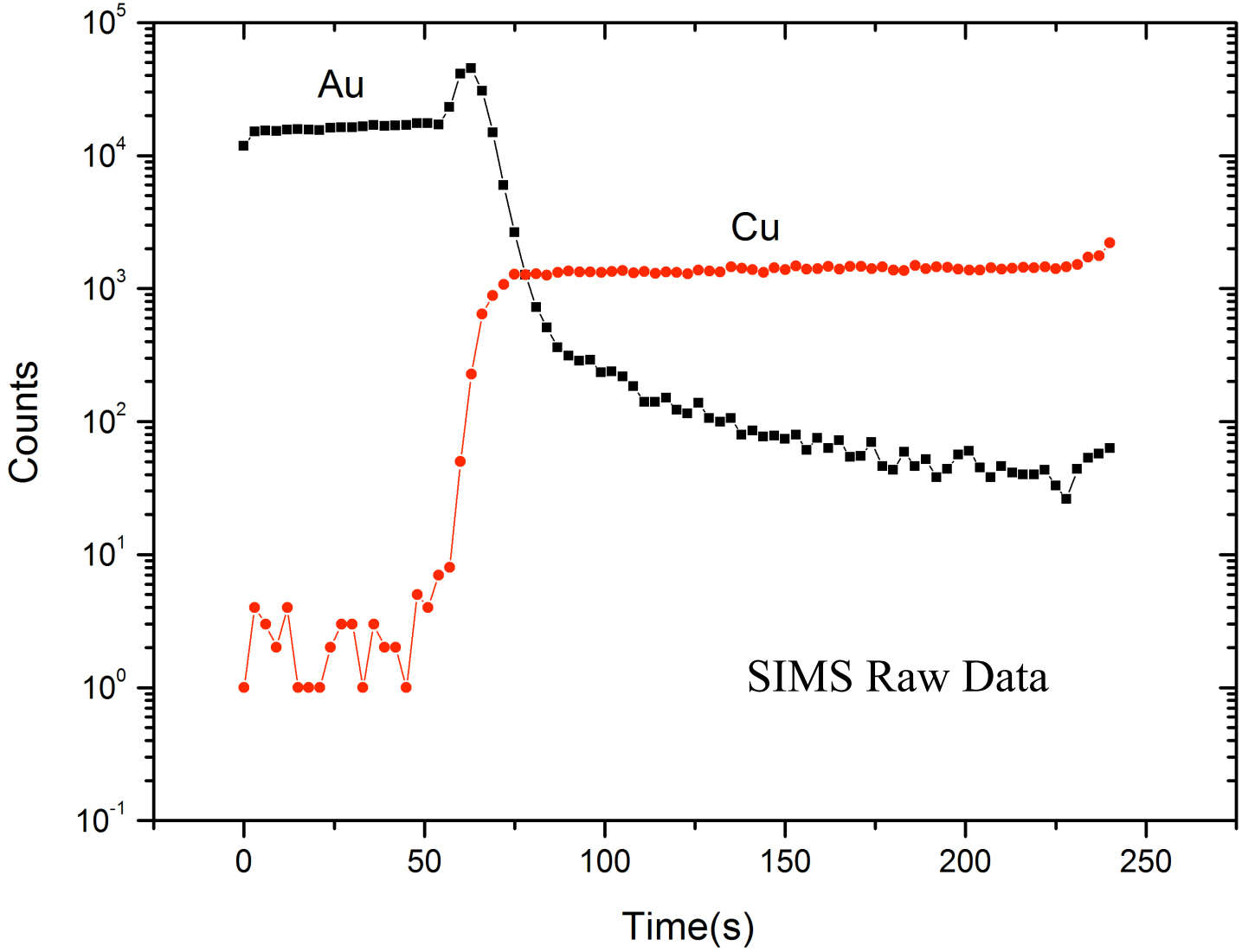


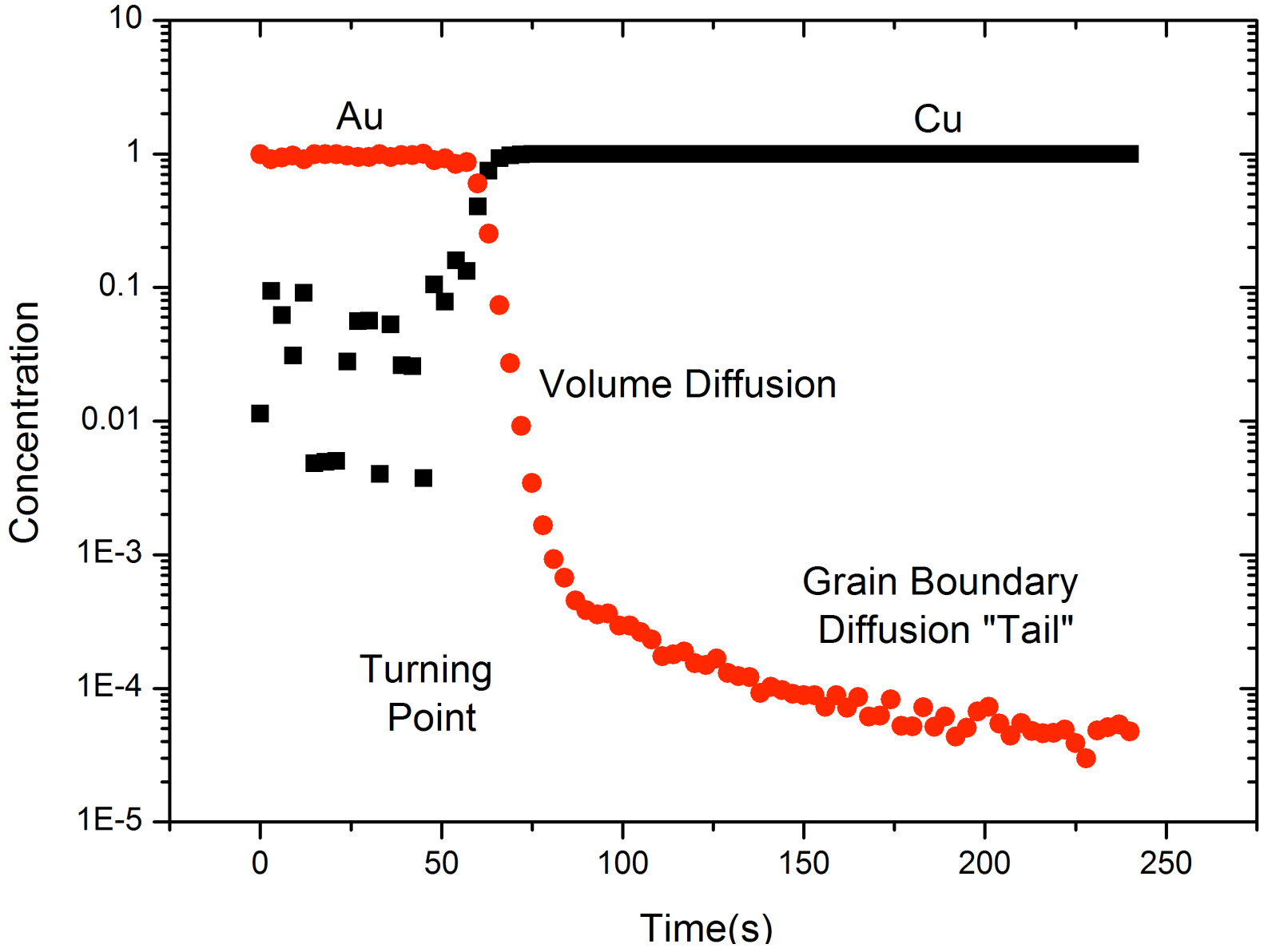


Based on RBS and AES Results

Translating SIMS Raw Data into Real Concentration is Possible

For example: Au (100nm)/Cu(200nm) Annealed at 373K 1Hr





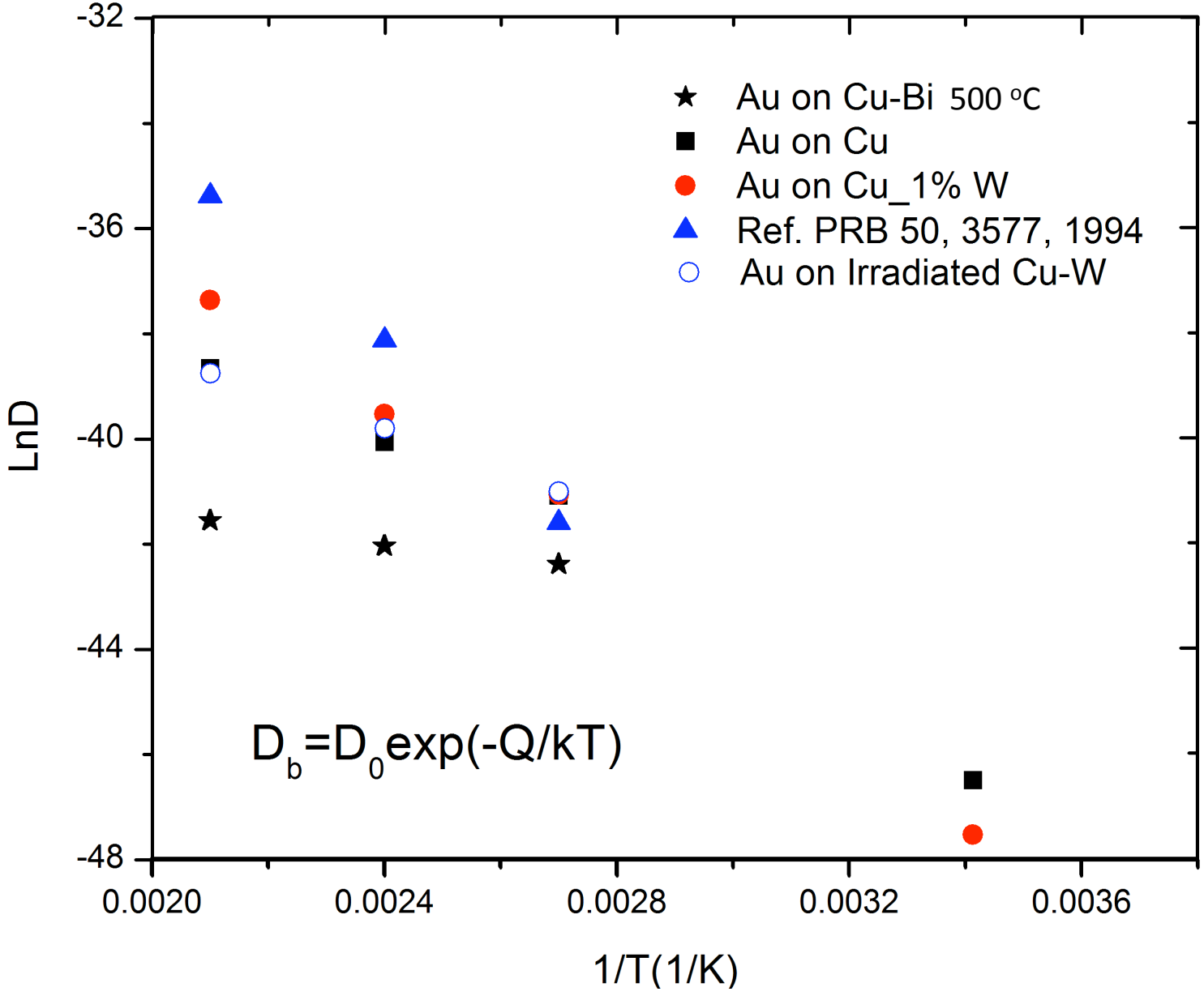
SIMS Raw Data Translated into Real Concentration by Calibration Results

Research Topics:

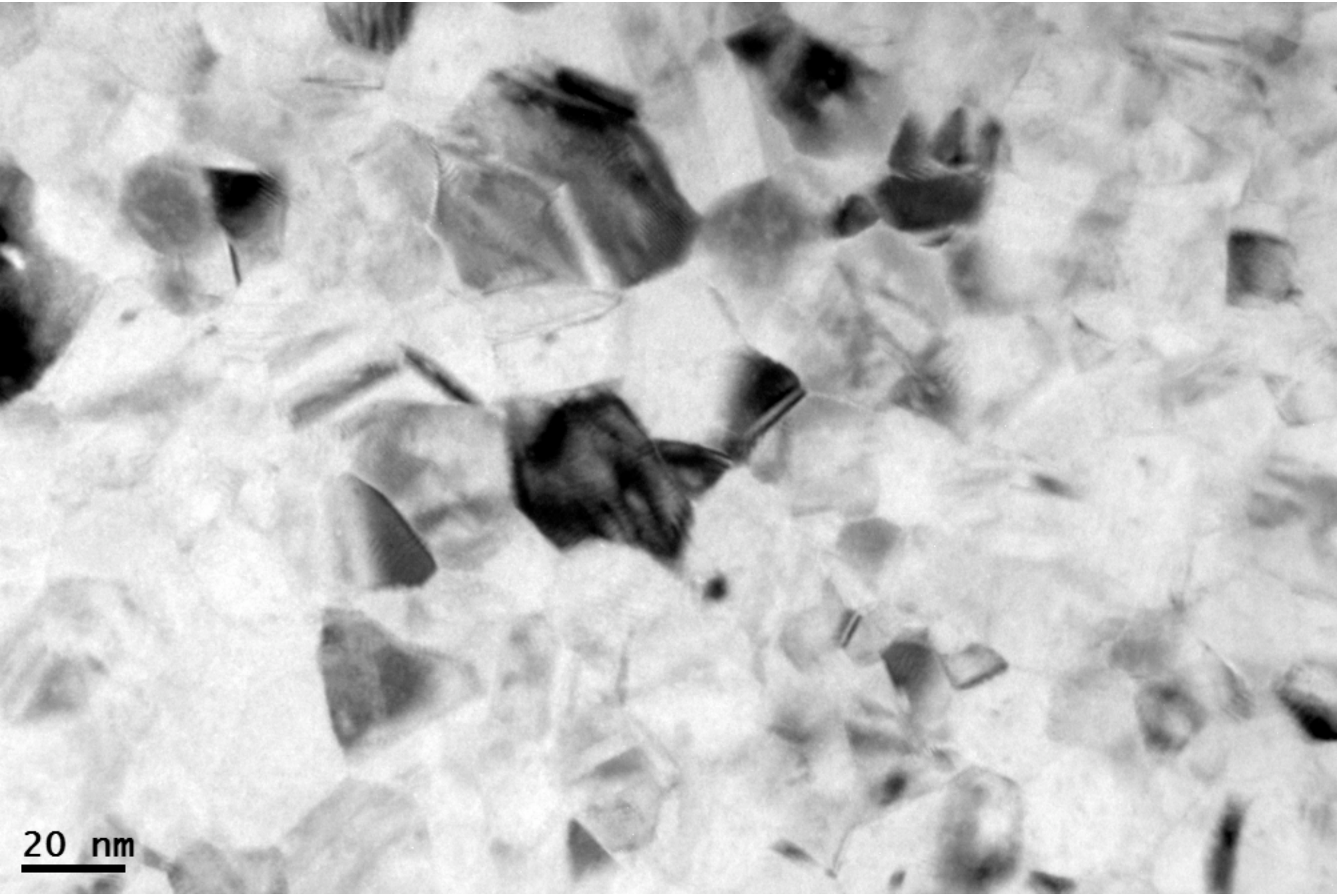
- Au Atoms diffusion along nano-crystal grain boundary by SIMS

Au in pure nano-crystal Cu (grain size effect)
Au in Cu-W alloy (chemical environment effect)
Au in irradiated Cu-W alloy (GB microstructure effect)
Au in Bi GB-doped Cu (Pure Cu annealed in Bi atm at 500C)

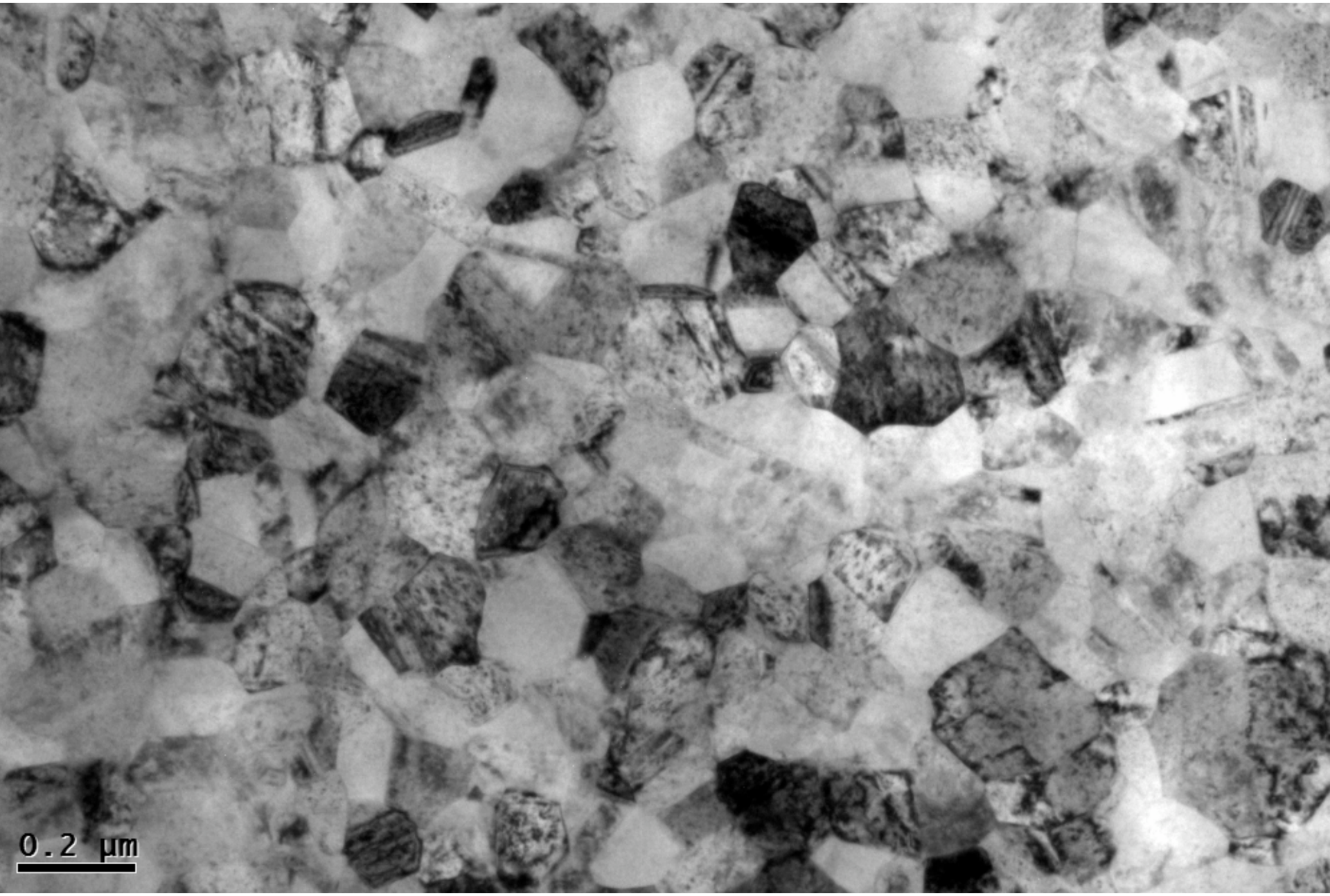
- Microstructures and chemical compositions by HREM, STEM, EDS



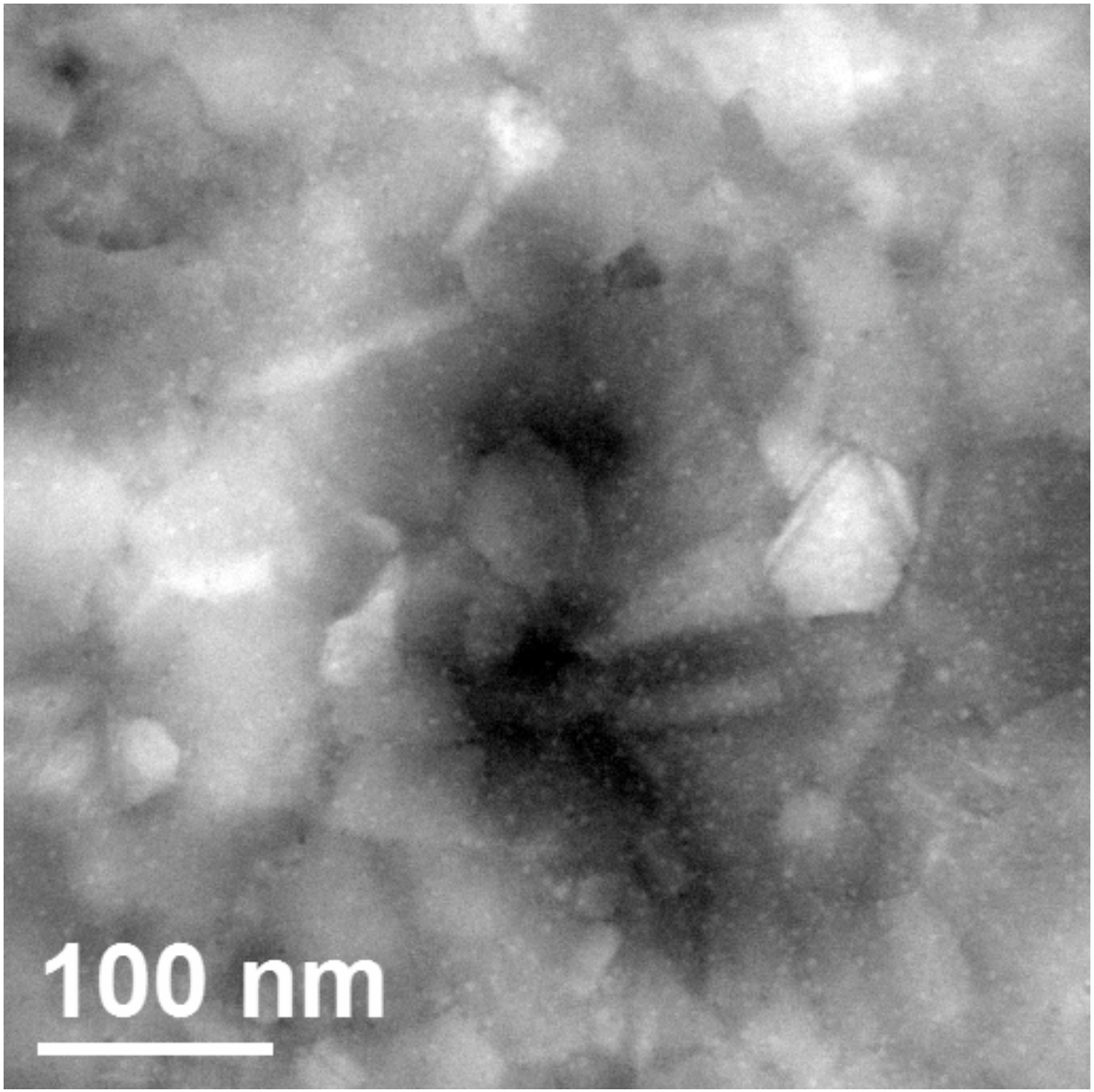
Type-C: Au Diffusivity at GB



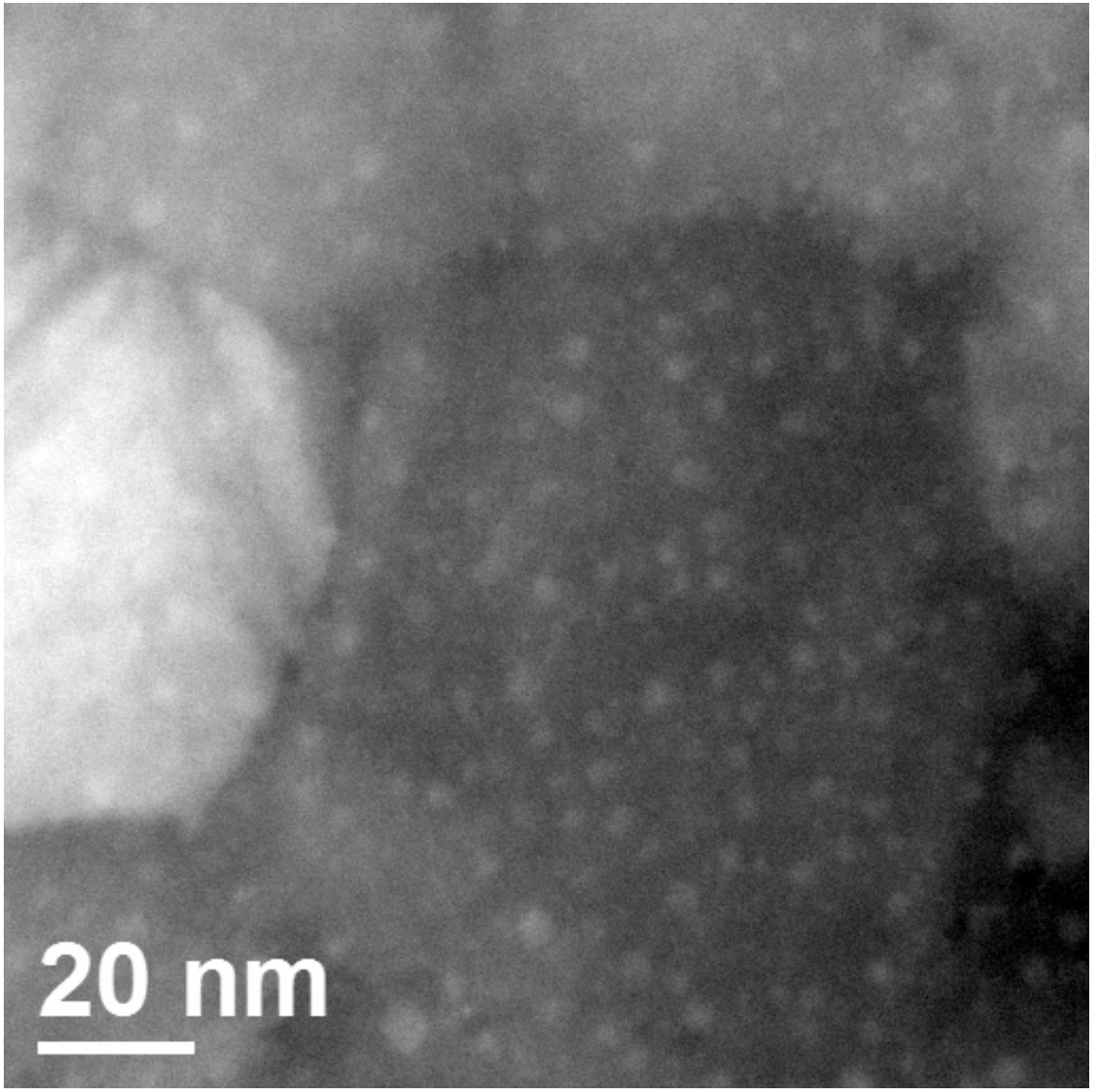
Cu-1%W as-deposited



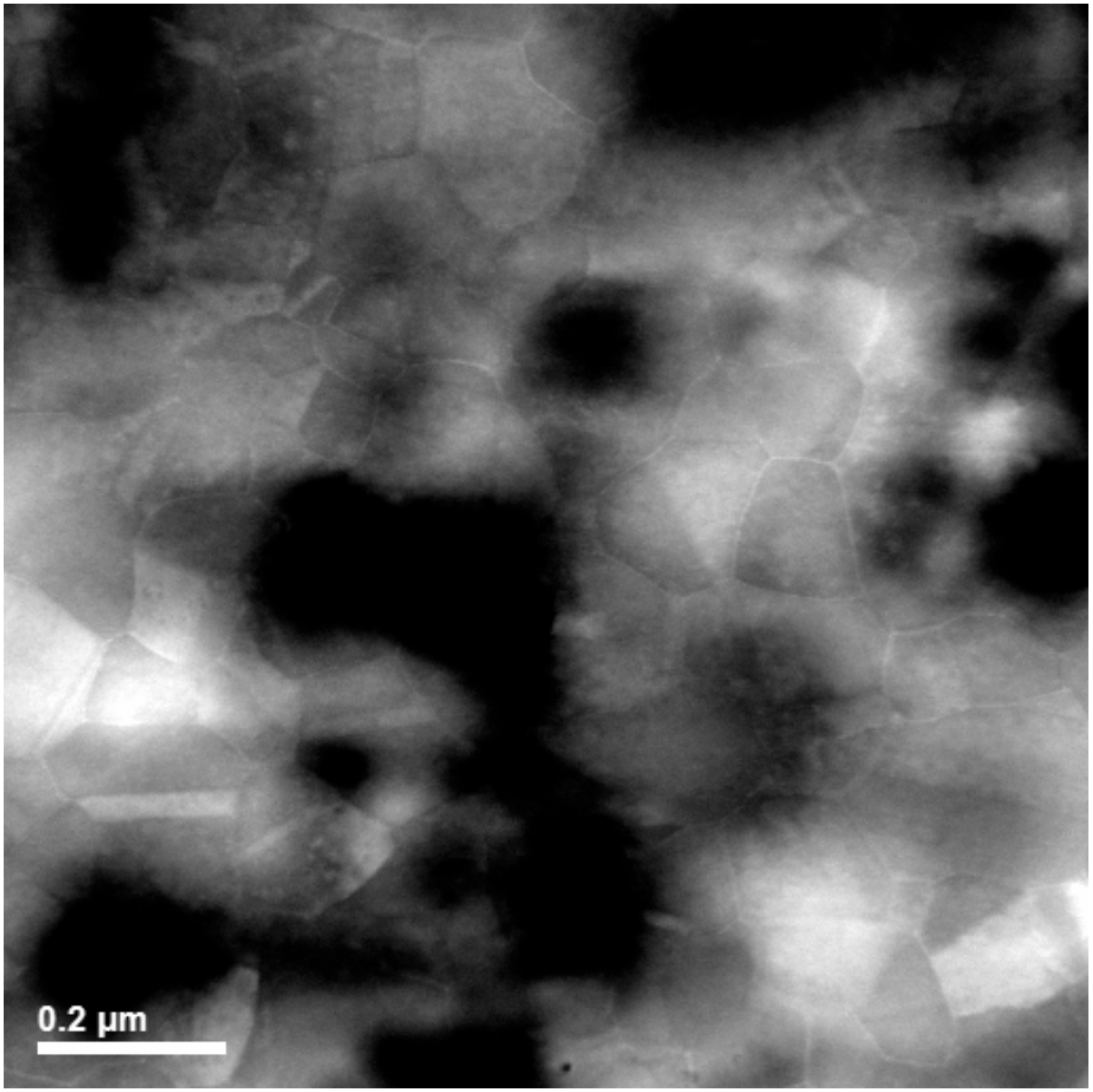
Cu-1%W after irradiation



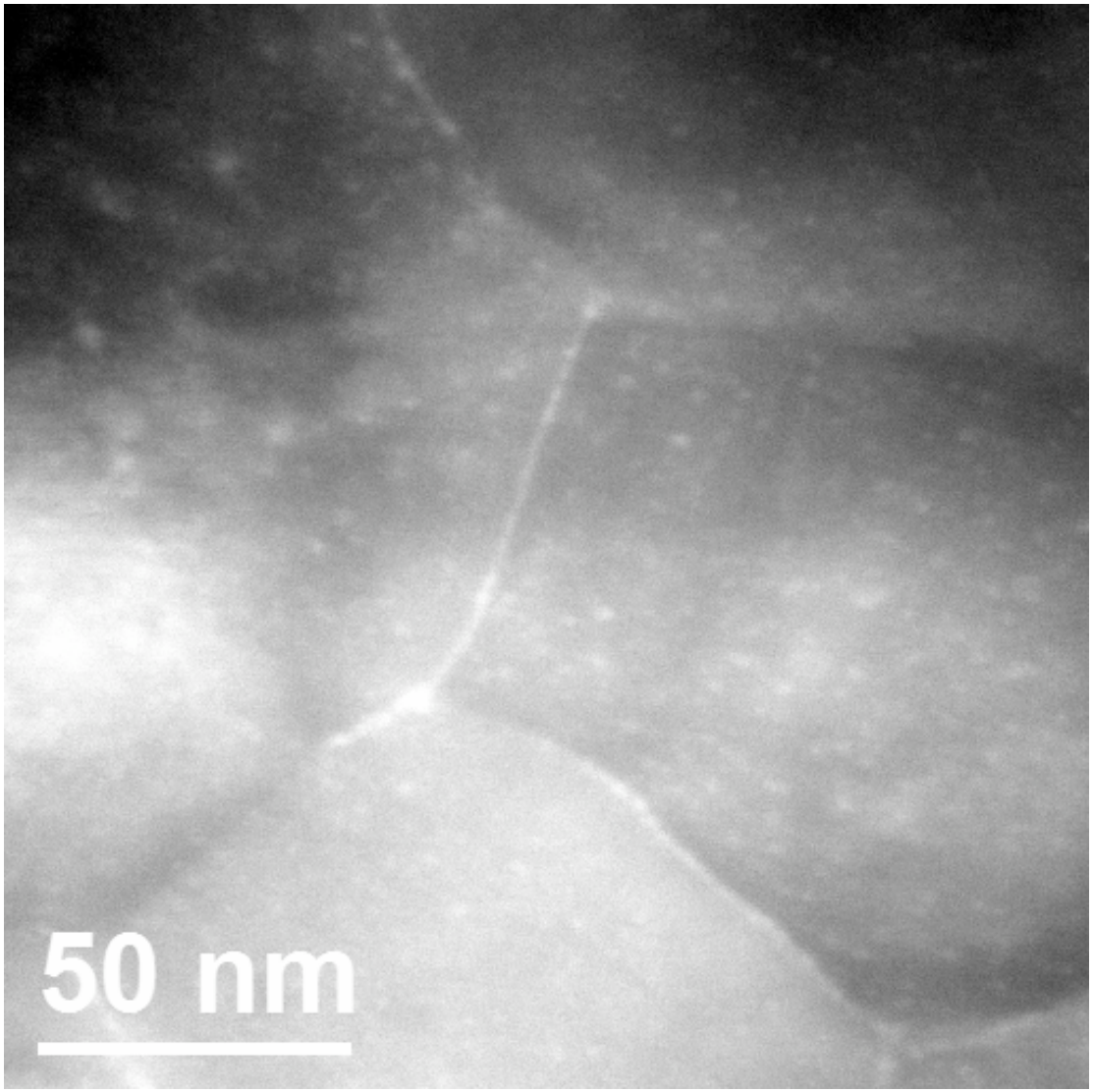
Cu-1%W after irradiation Z-contrast



Cu-1%W after irradiation Z-contrast (bright spot: W-nanoparticles)



Type C: Au diffusion along Cu-1%W (irradiation) GB Z-contrast
(bright spot: W-nanoparticles, bright GB: Au-enriched)



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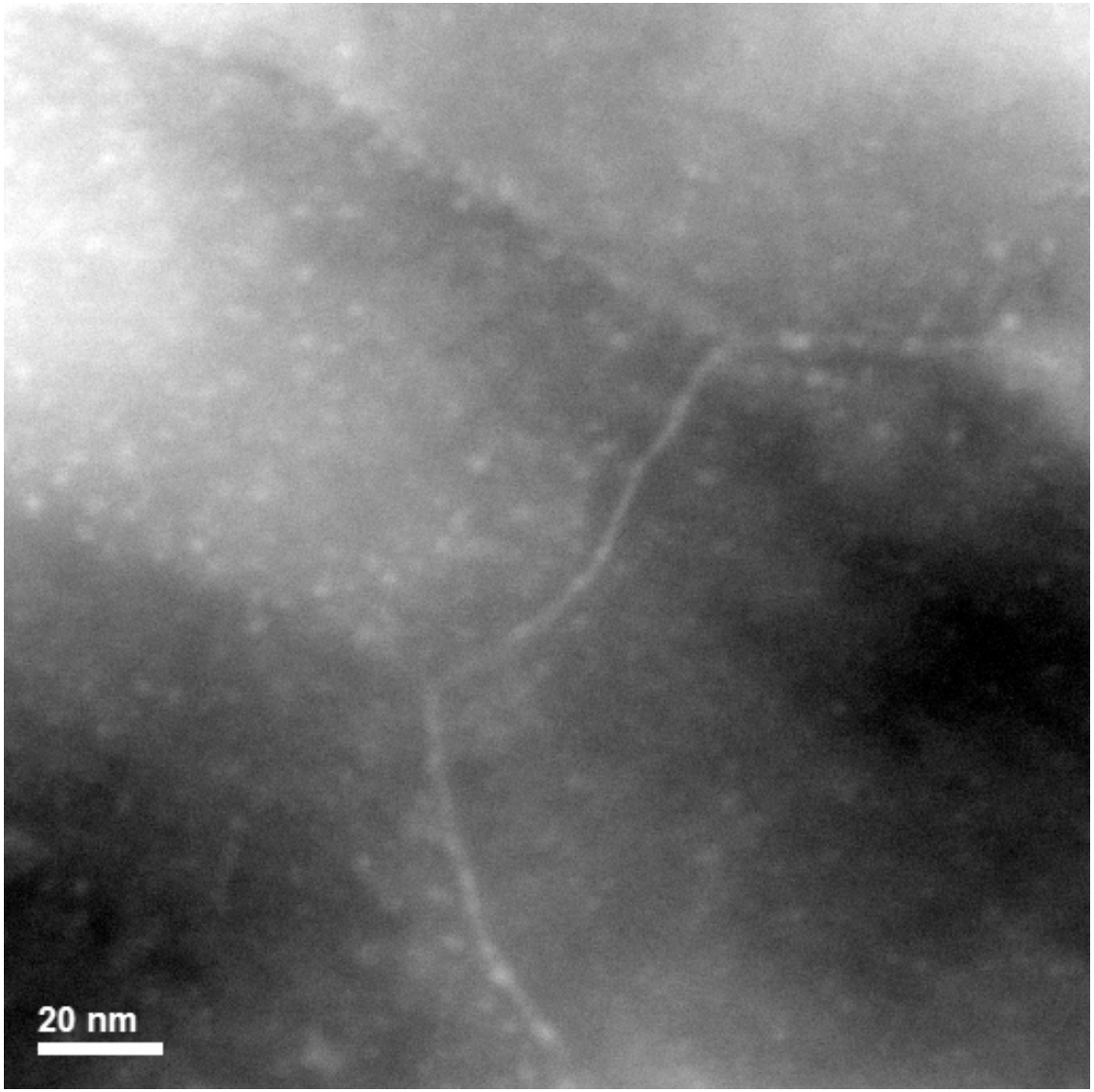

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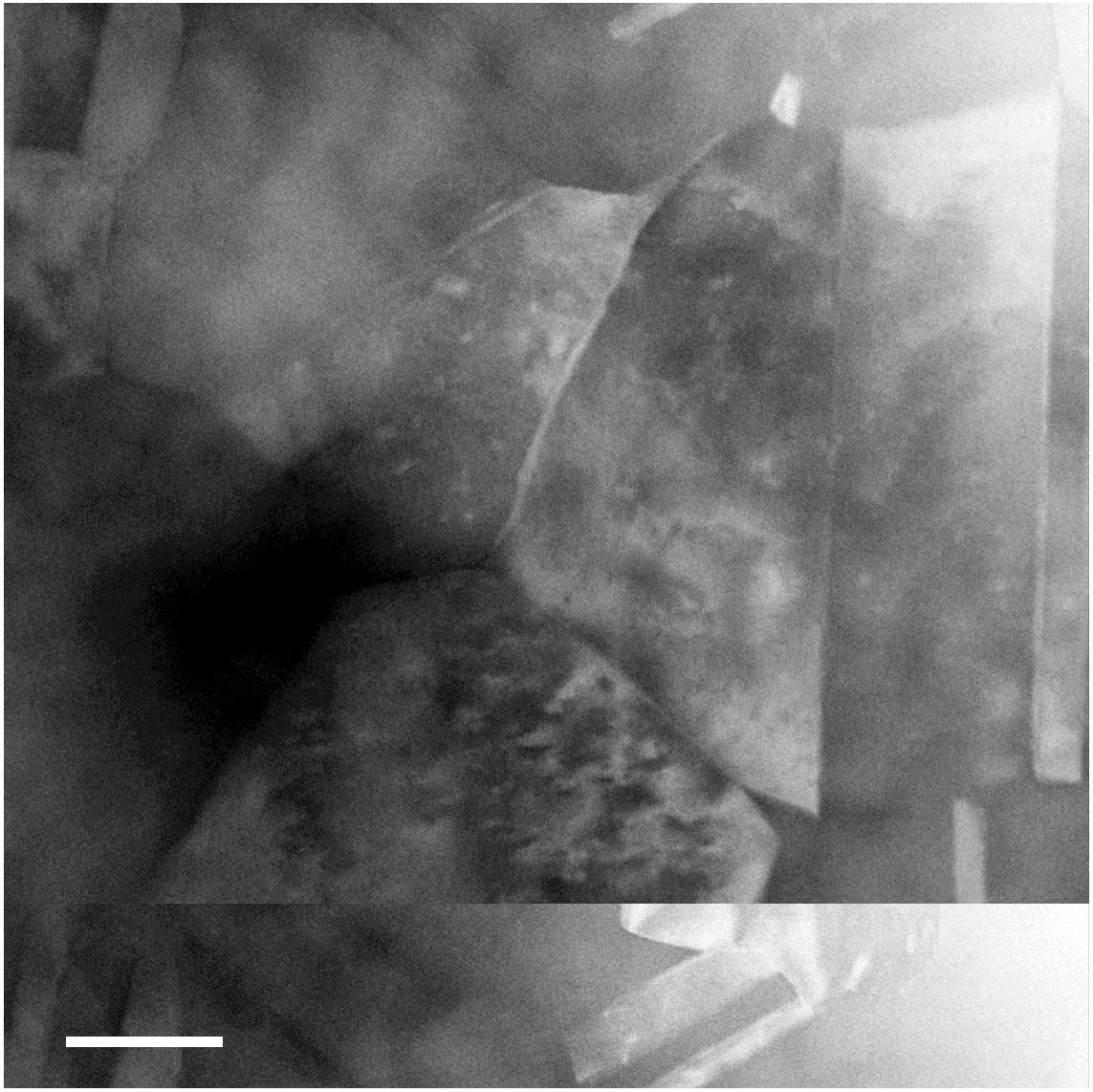
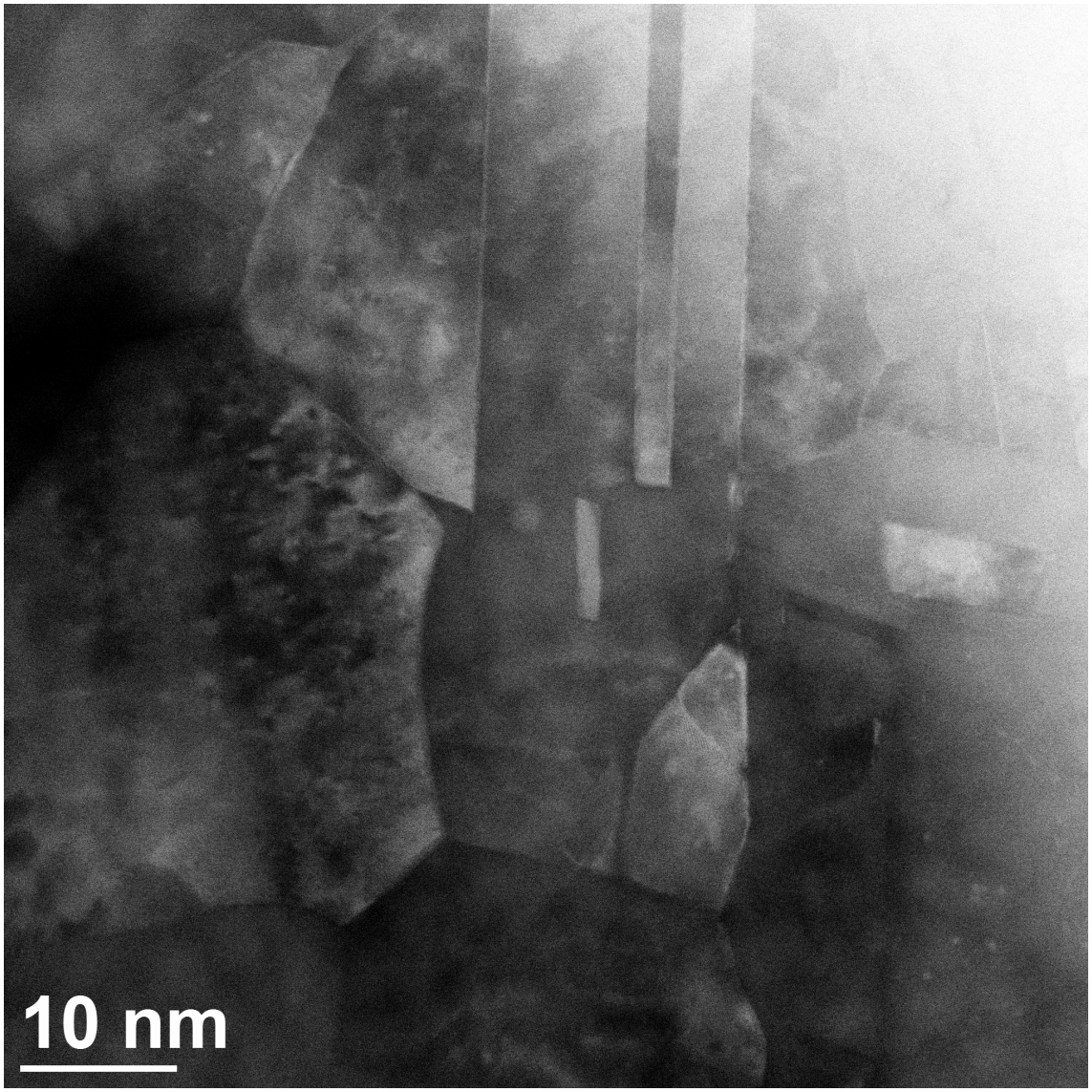


Bi diffusion along pure Cu GB Z-contrast (bright GB: Bi-enriched)



Bi diffusion along pure Cu GB Z-contrast (bright GB: Bi-enriched)