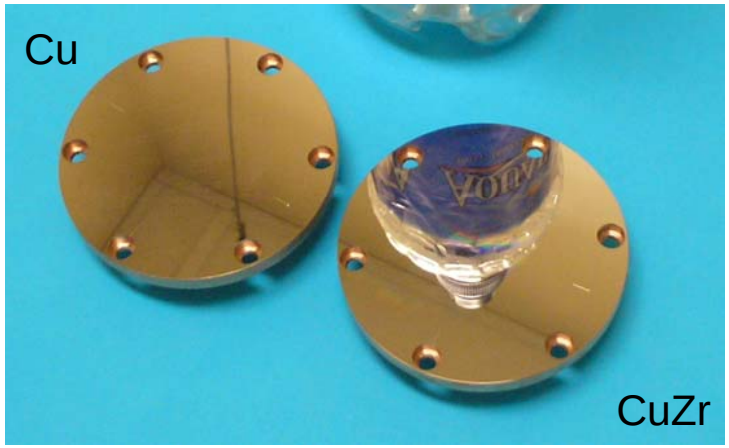
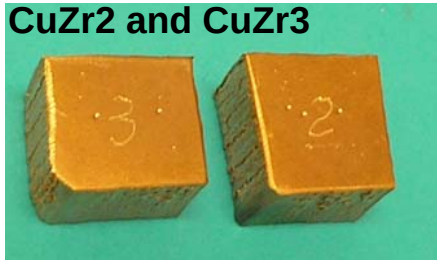
2nd Collaboration Meeting on X-band Accelerator Structure Design and Test Program

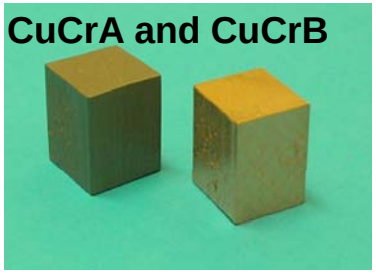
Pulse Heating, Surface Analysis, and Hardness Testing

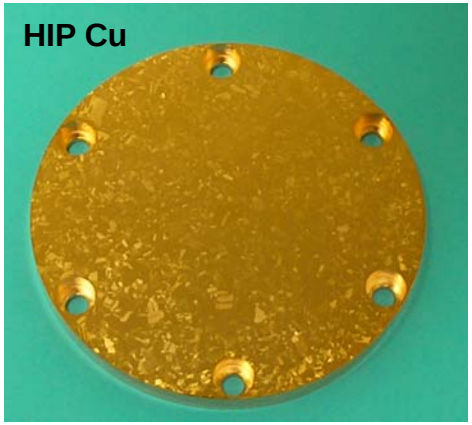
L. Laurent

SLAC

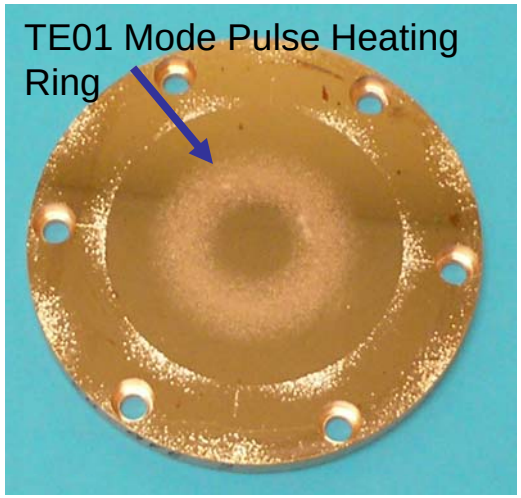




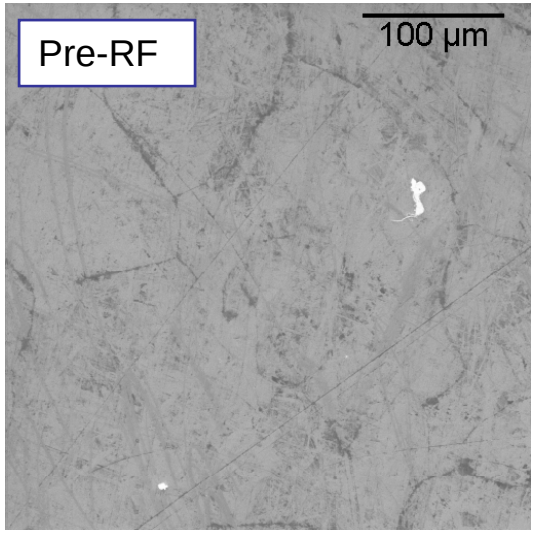


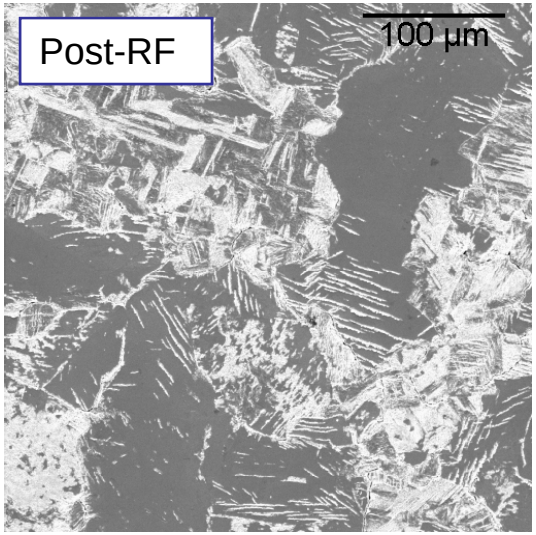


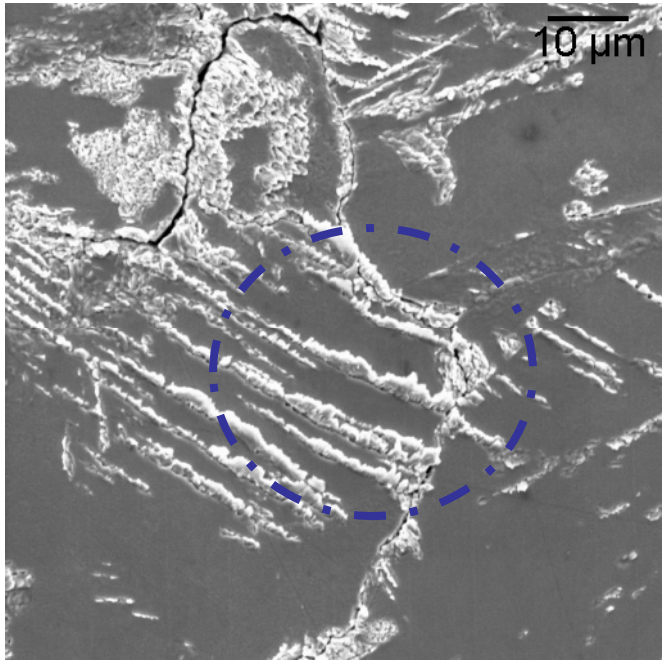
Cu2: SEM Images Inside Pulse Heating Region

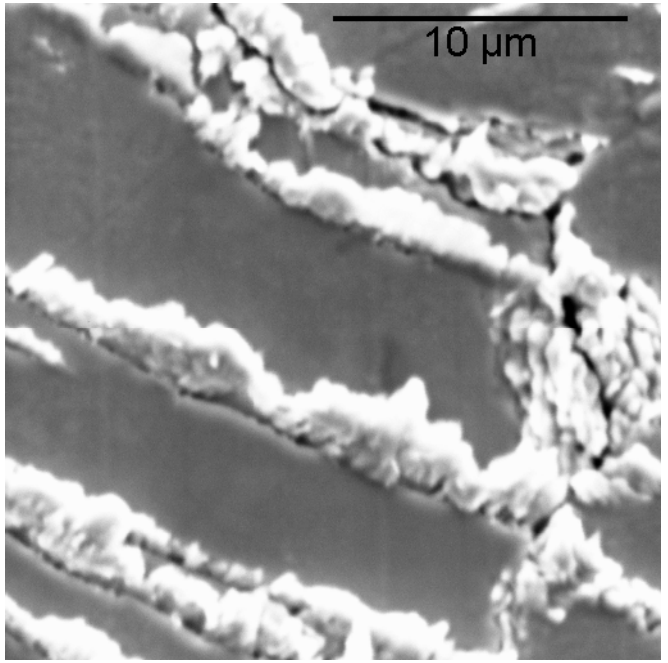


Temp = 110°C









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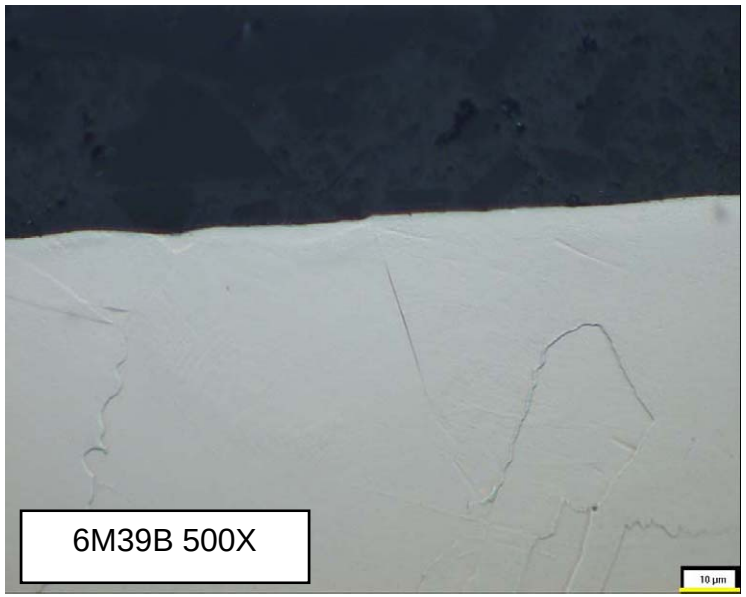
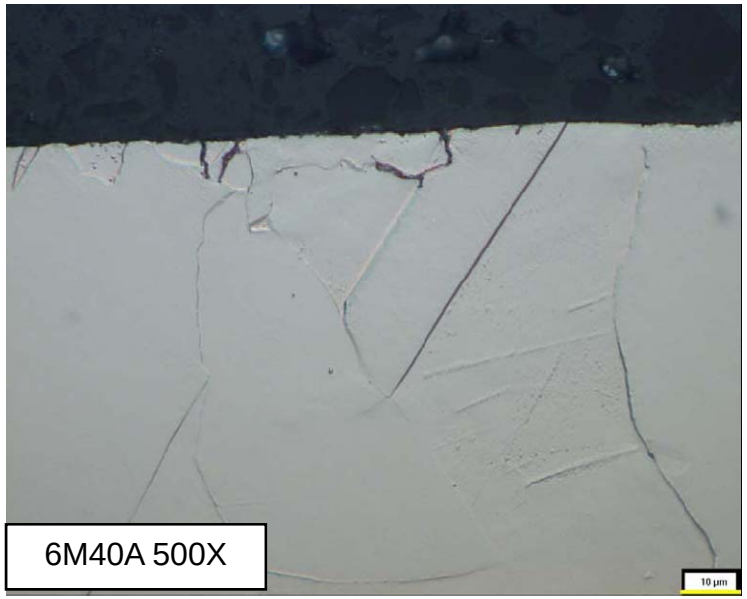
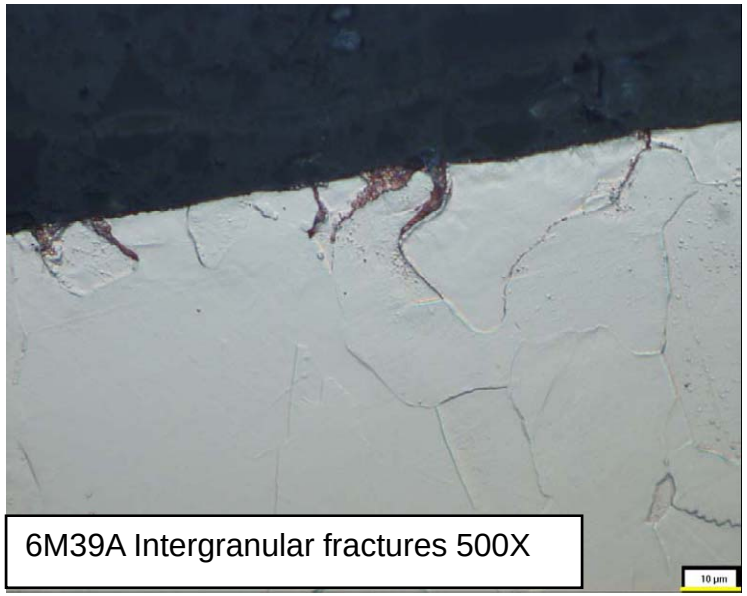
Metallography of Pulse Heating Sample Cu2 After RF Test

Images taken
Outside of Pulse
Heating Region





Images taken
Inside of Pulse
Heating Region



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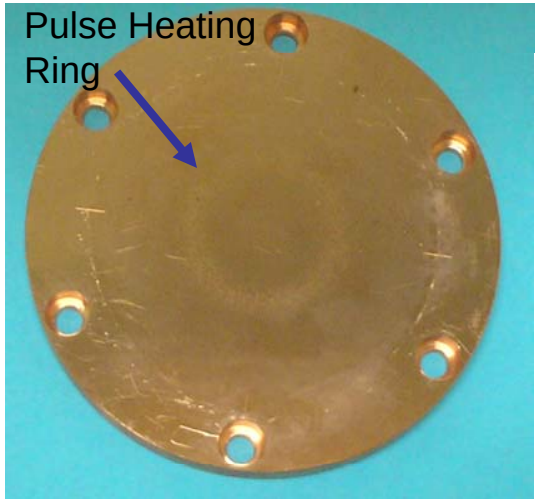
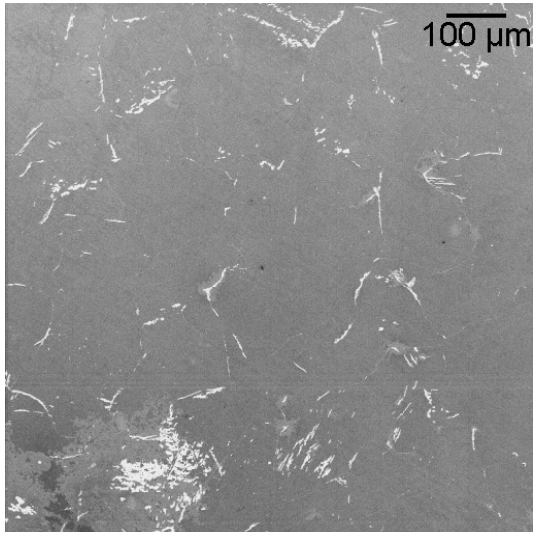
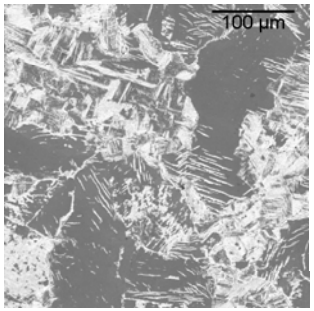
Cu1: Temp=70°C



Cu1

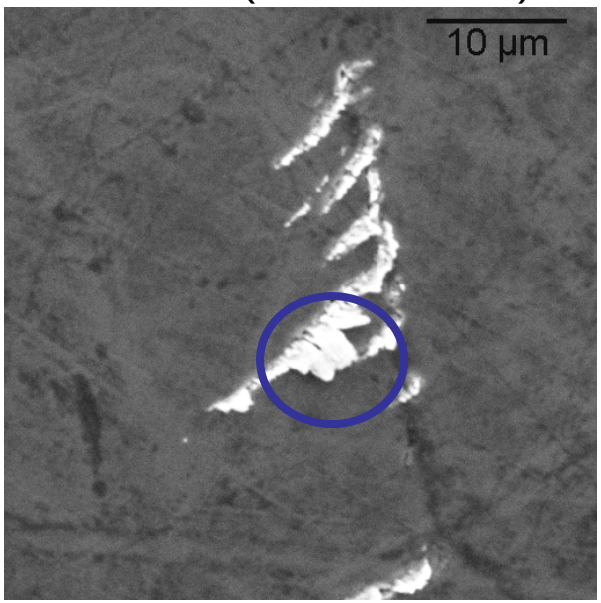


Cu2: T=110°C

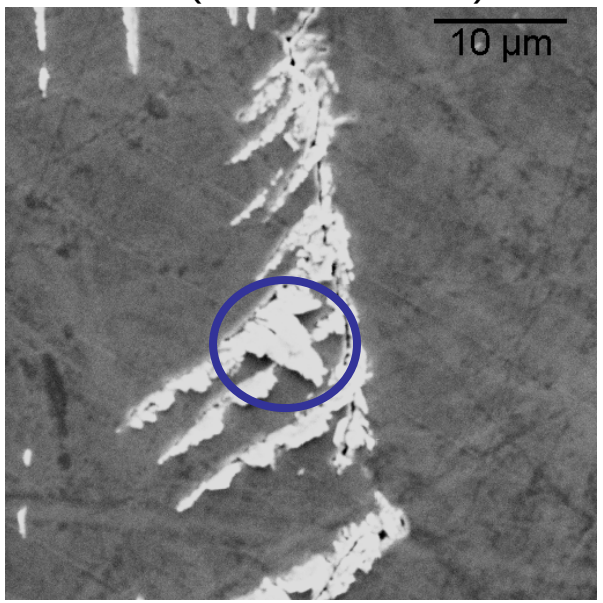


For Comparison

Cu1 (after 1st rf test)



Cu1 (after 2nd rf test)



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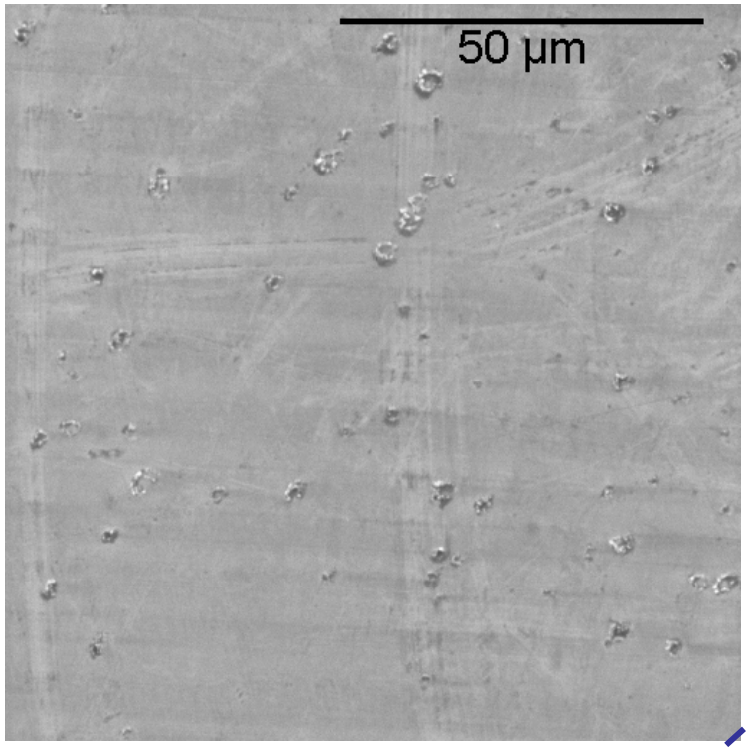
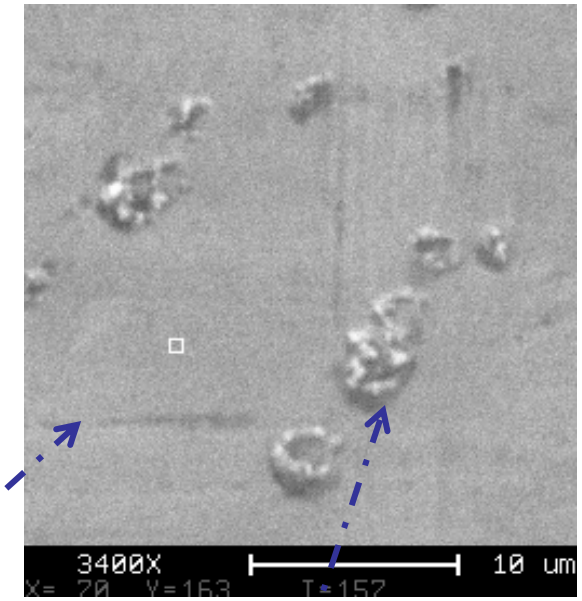
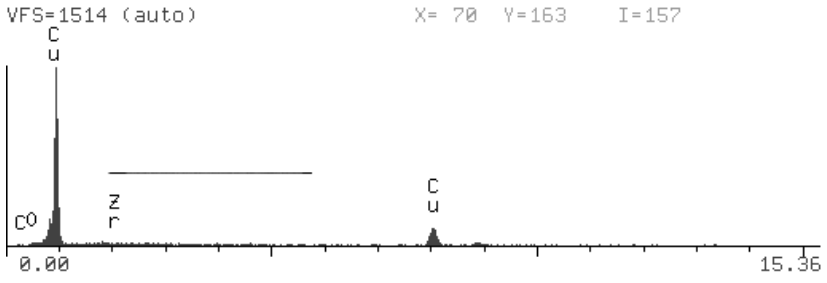
Pulse Heating Sample CuZr2:
SEM Images Prior to RF Testing

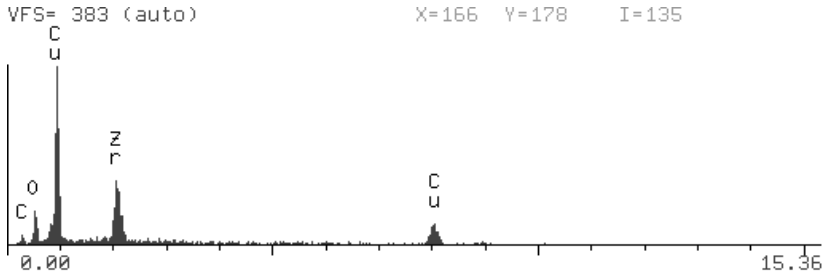




Copper

Zirconium





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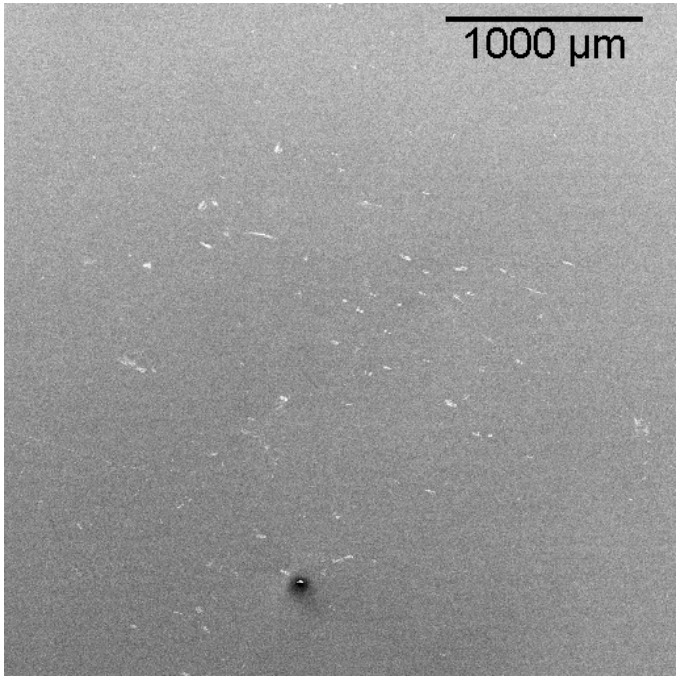
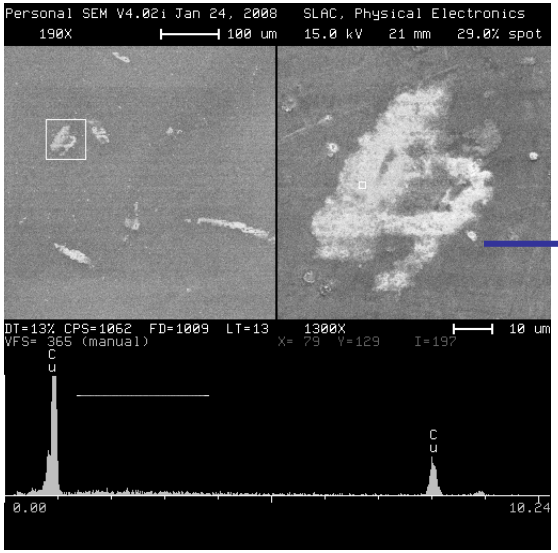
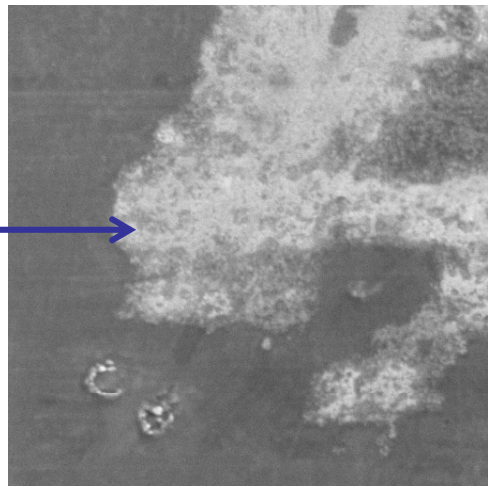
CuZr2

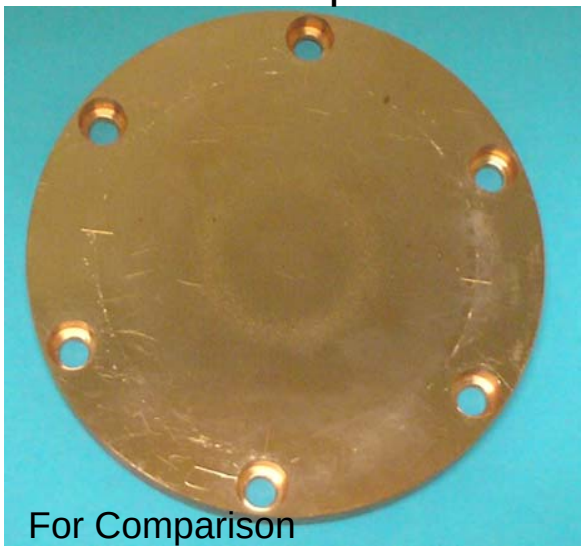


CuZr2: Temp=70°C





Cu1: Temp=70°C



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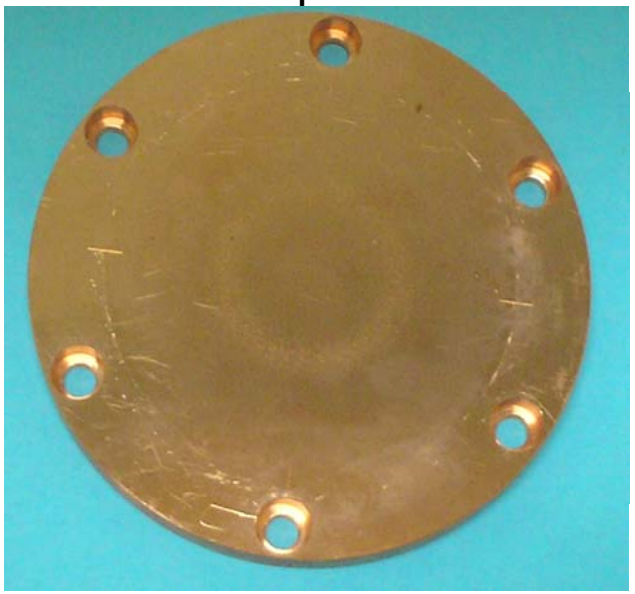
CuZr1: Temp=100°C

Cu1: Temp=70°C



CuZr2: Temp=70°C

Cu2: Temp=110°C

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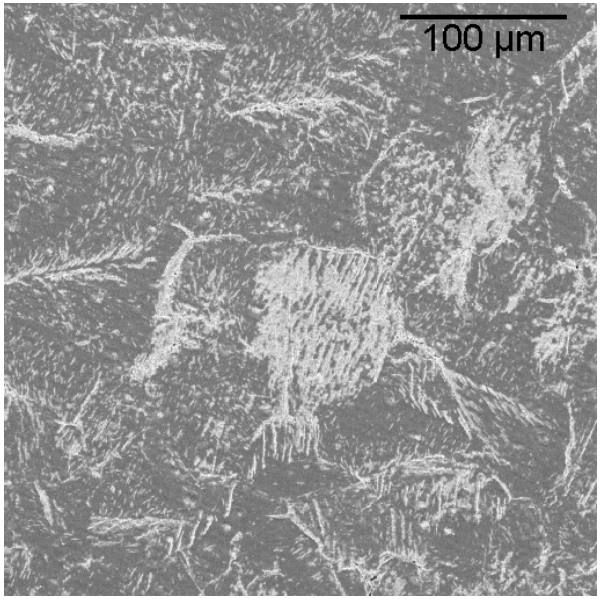
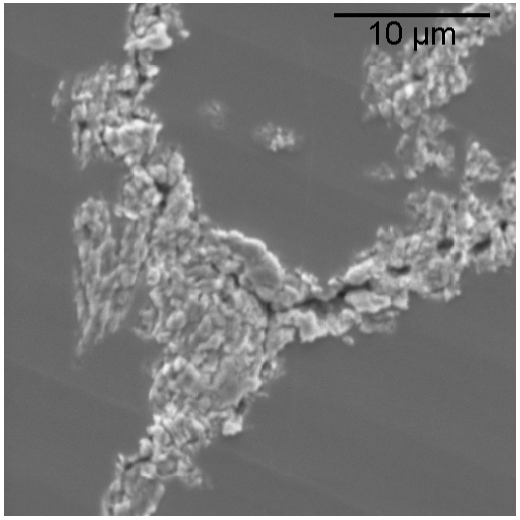
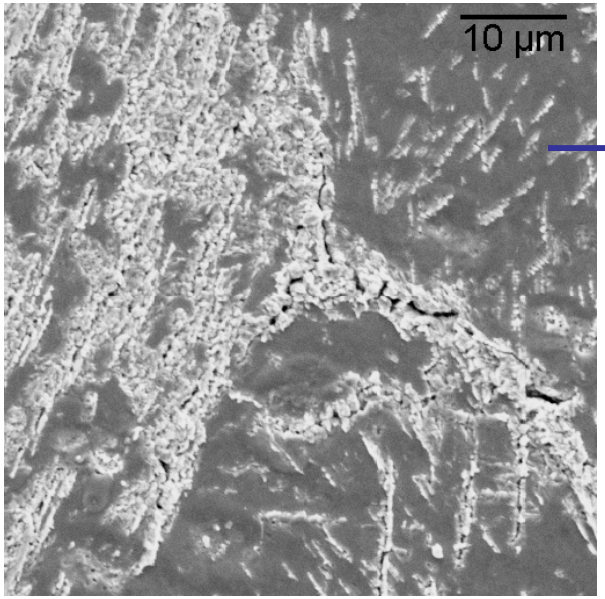
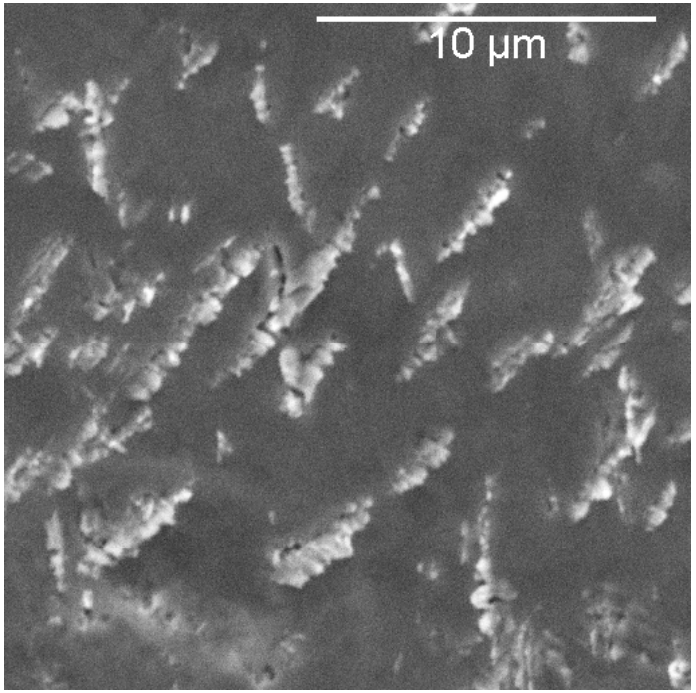
CuZr1: Temp = 100°C









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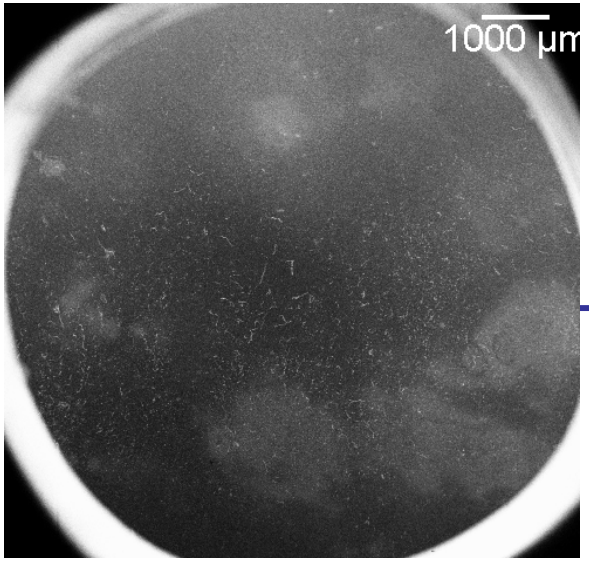
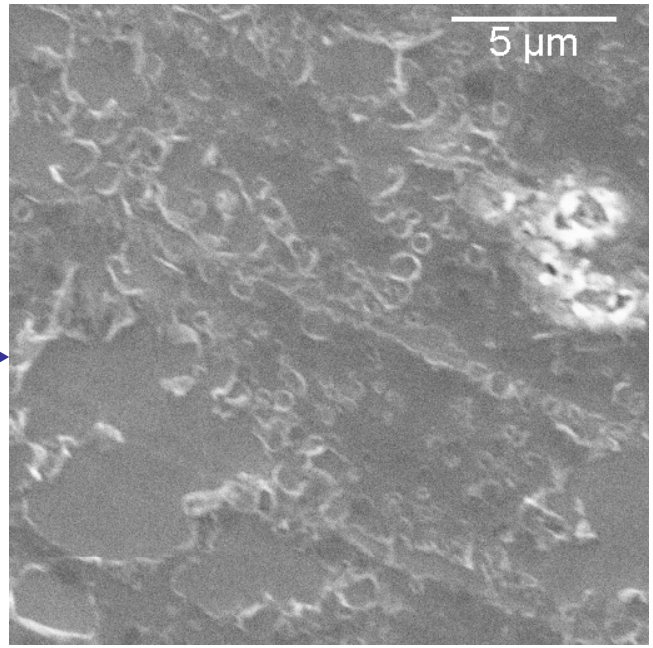
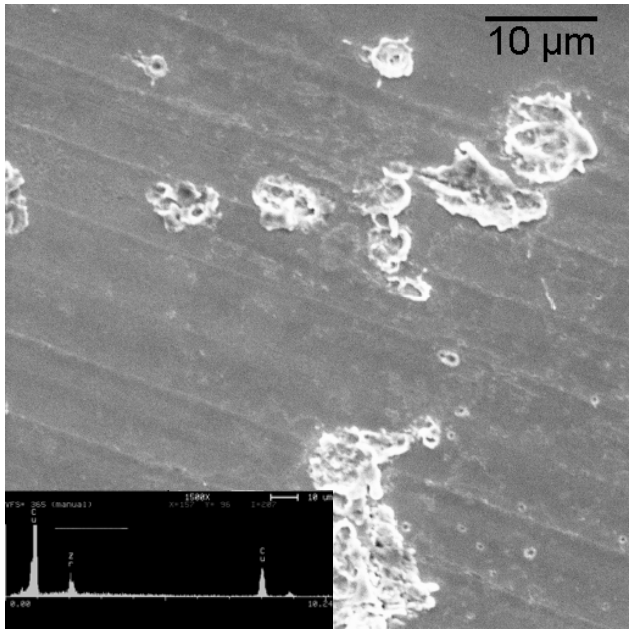
CuZr1: Temp = 100°C







Breakdown Sites at location of Zirconium Particles

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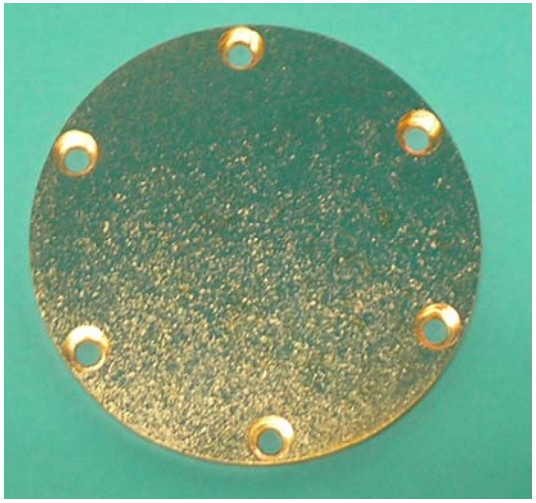
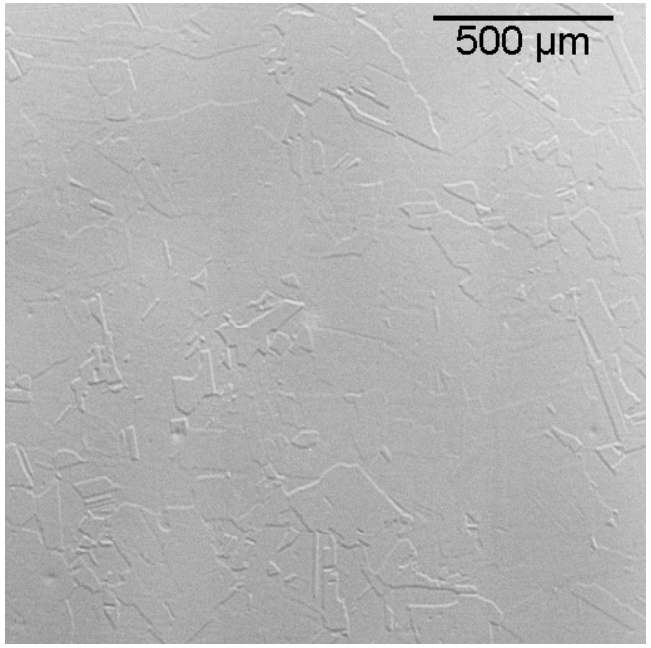
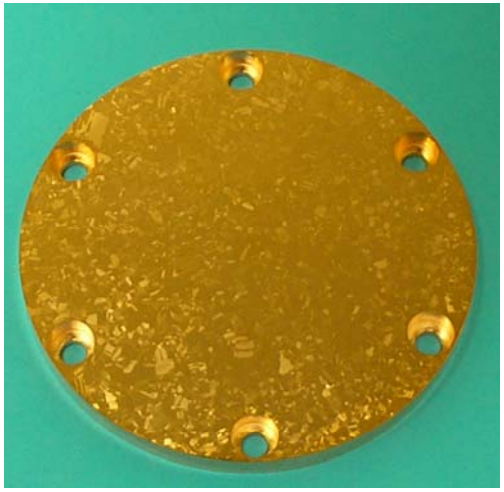
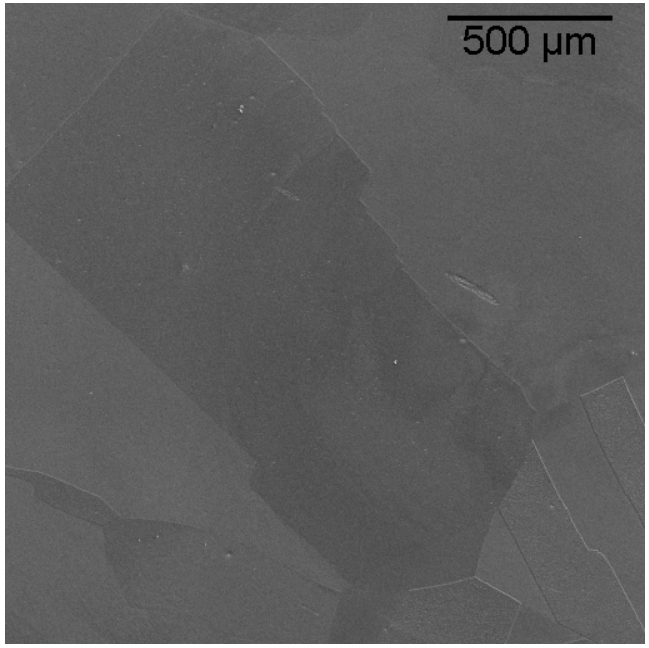
Cu KEK_3 (Etched & H2 Fired): In Test





HIP Cu (Etched): Next to be Tested





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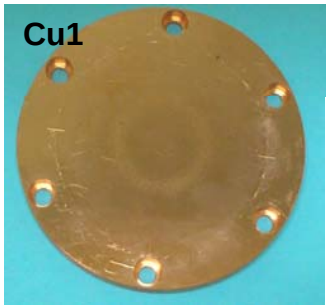
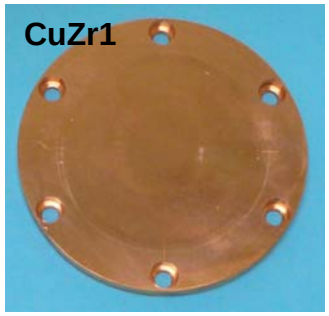
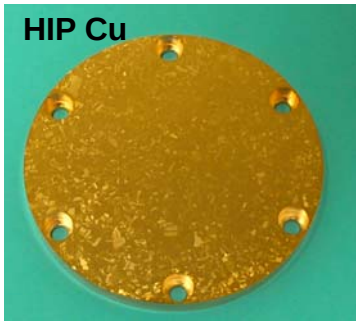
Surface Analysis and Hardness Test Measurements on Copper, Copper Zirconium, and Copper Chromium Before and After Heat Treatment

CERN

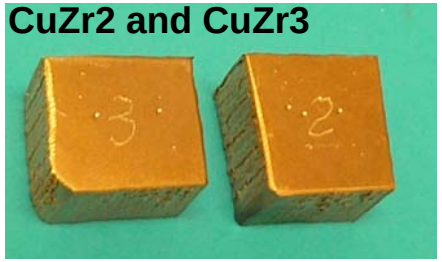




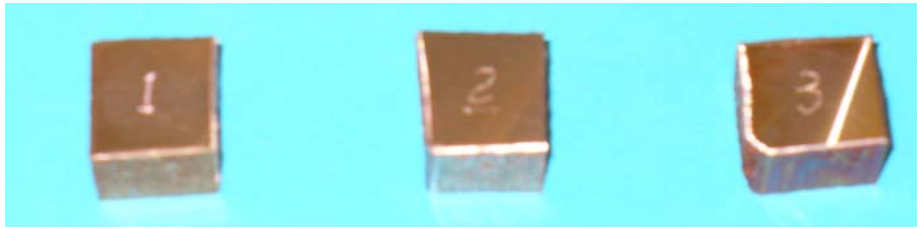
KEK

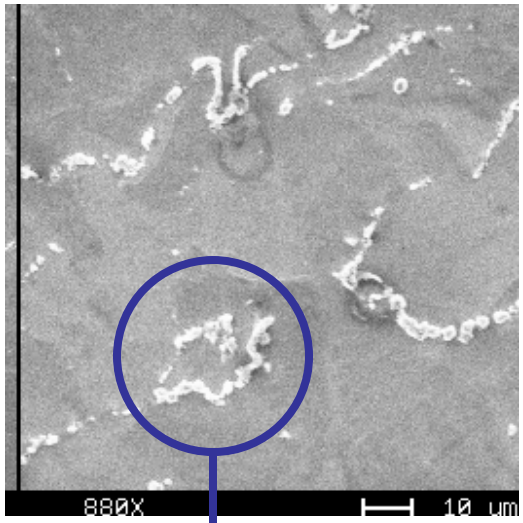


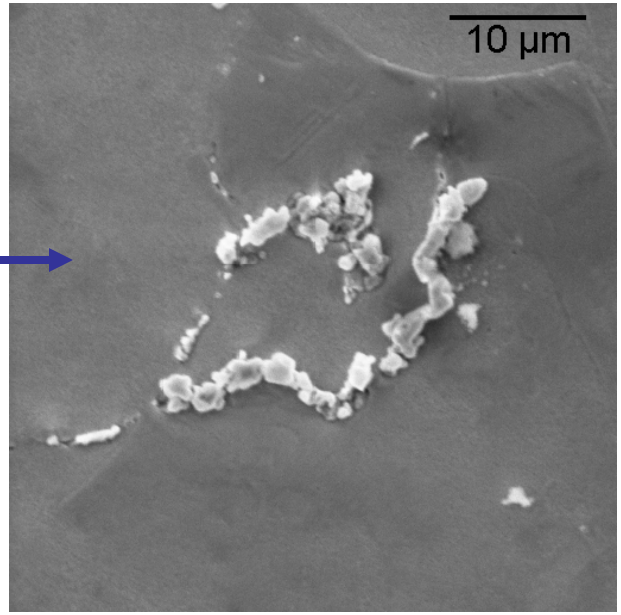
SLAC

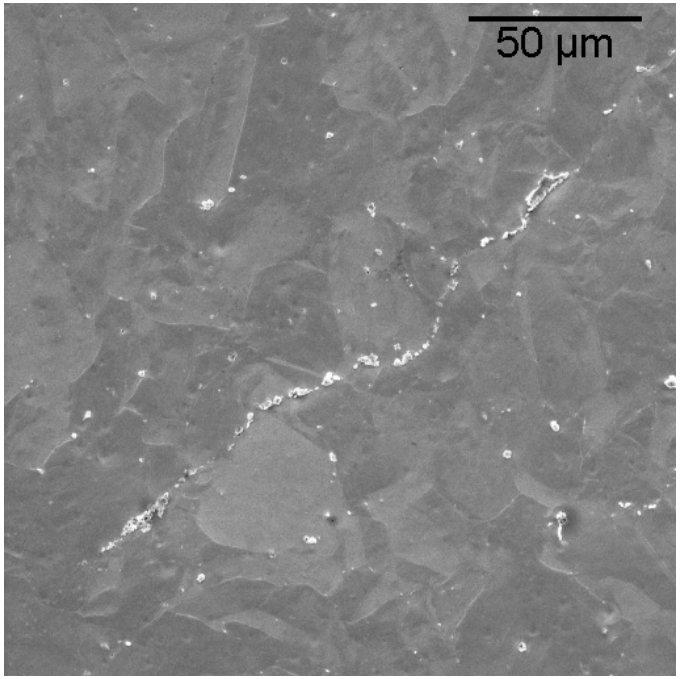


SLAC: CuZr Samples

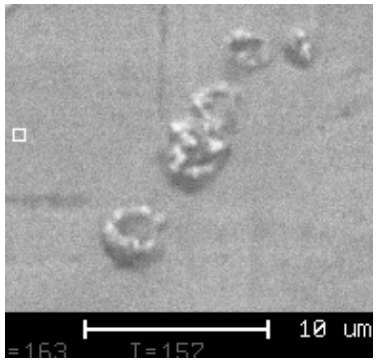








CuZr Pulse Heating Sample (For comparison)



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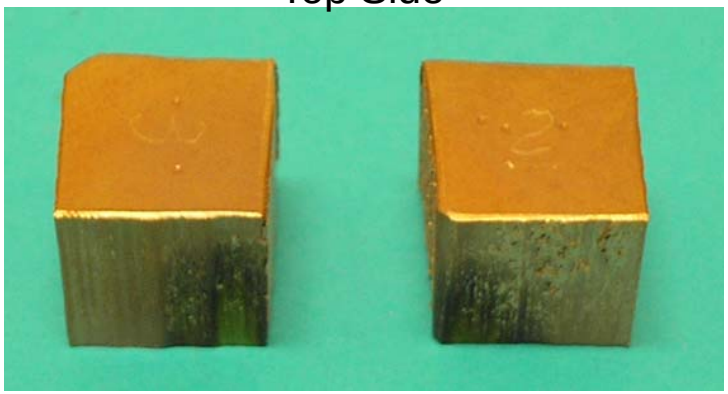
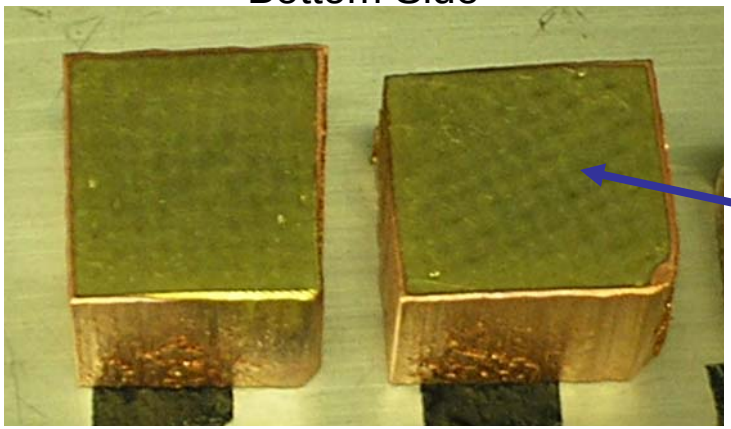
SLAC CuZr Samples H2 Fired to 980°C: Top Side

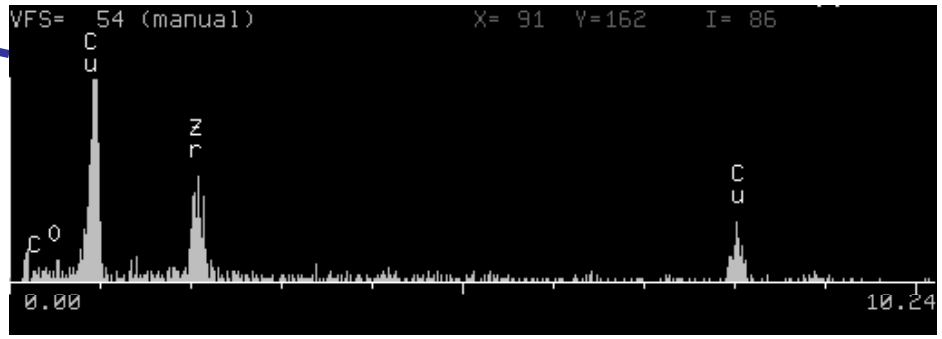
Top Side



Samples in furnace

Bottom Side





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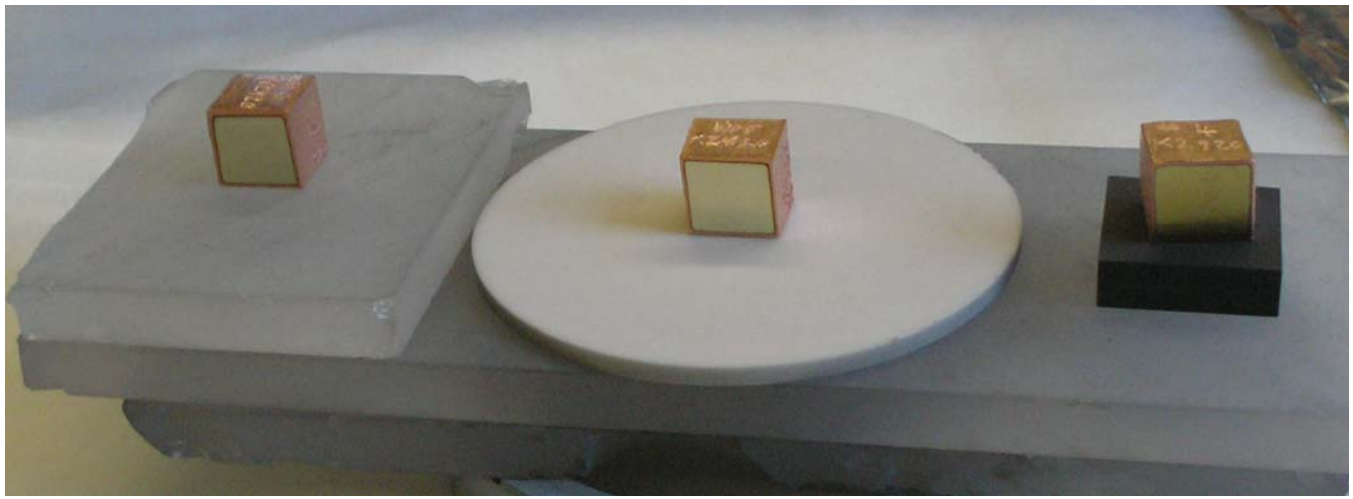
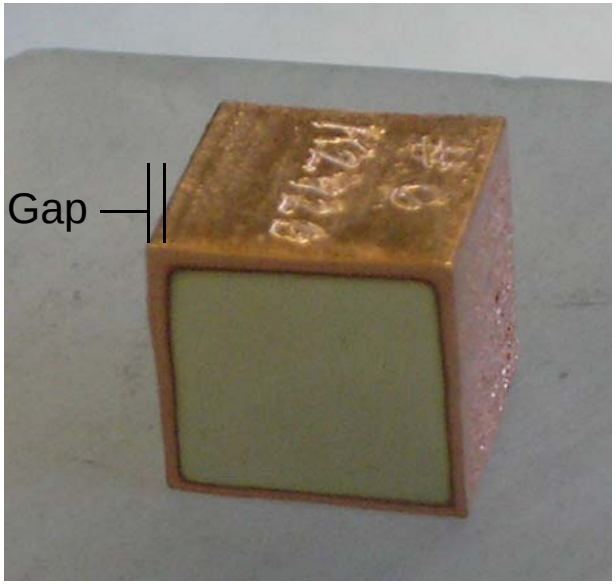
SLAC CuZr Samples H2 Fired to 980°C: Bottom Side



Quartz Ceramic Carbon



Top and bottom side of copper coupon H2 fired

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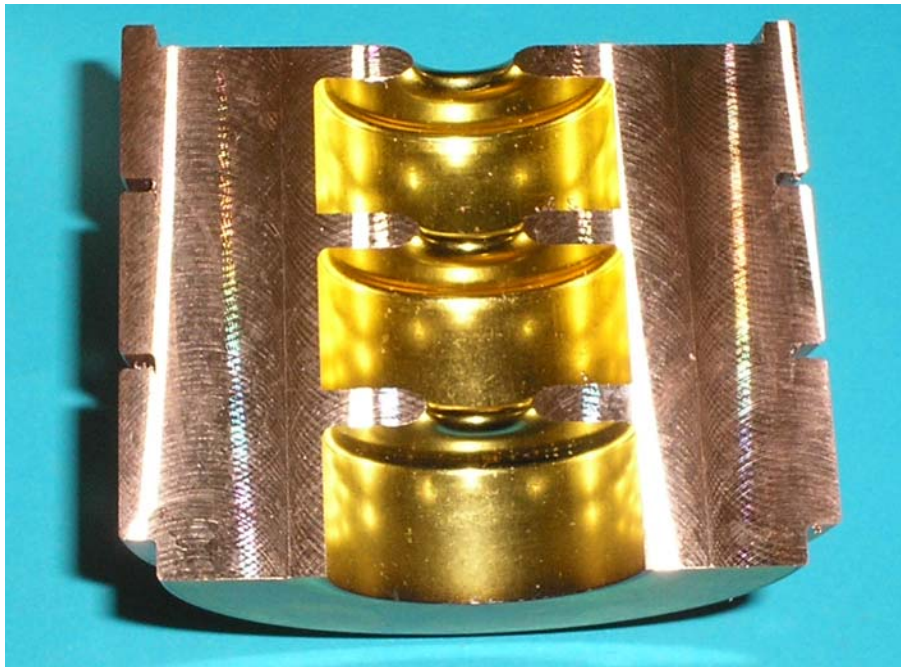
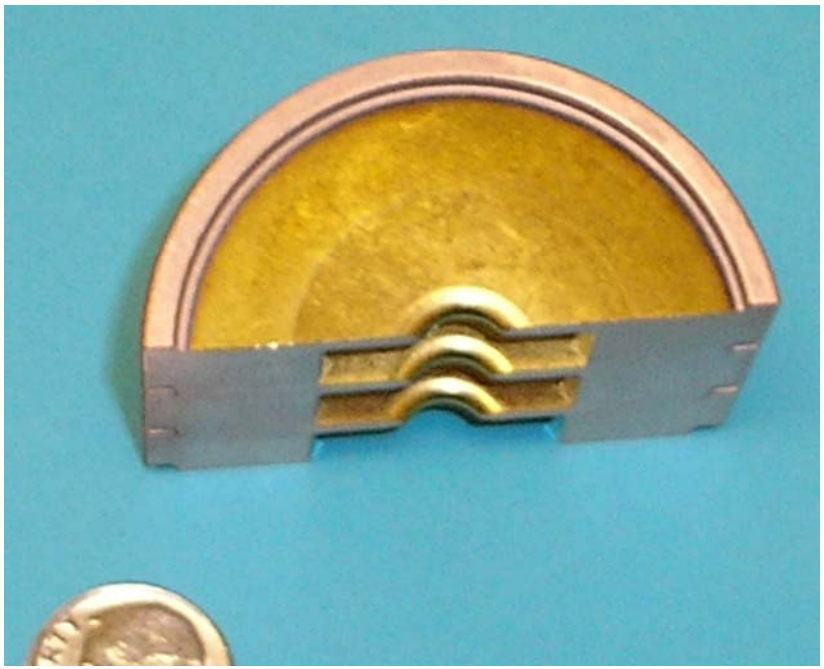
CuZr Single Cell Structure H2 Fired to 980^{o}C





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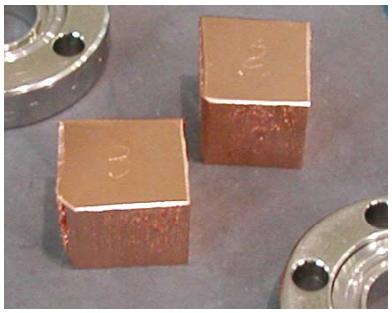
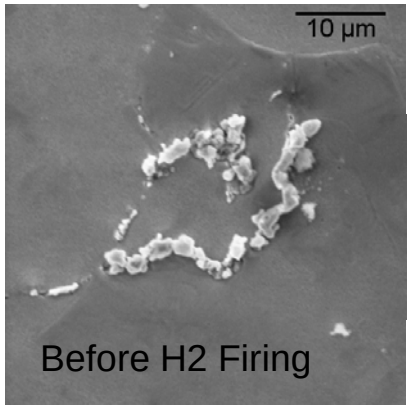
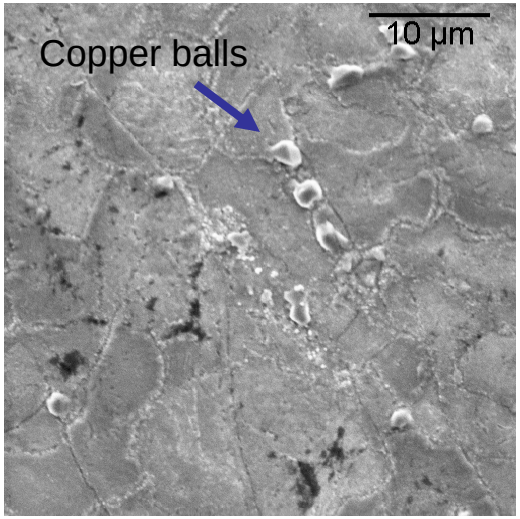
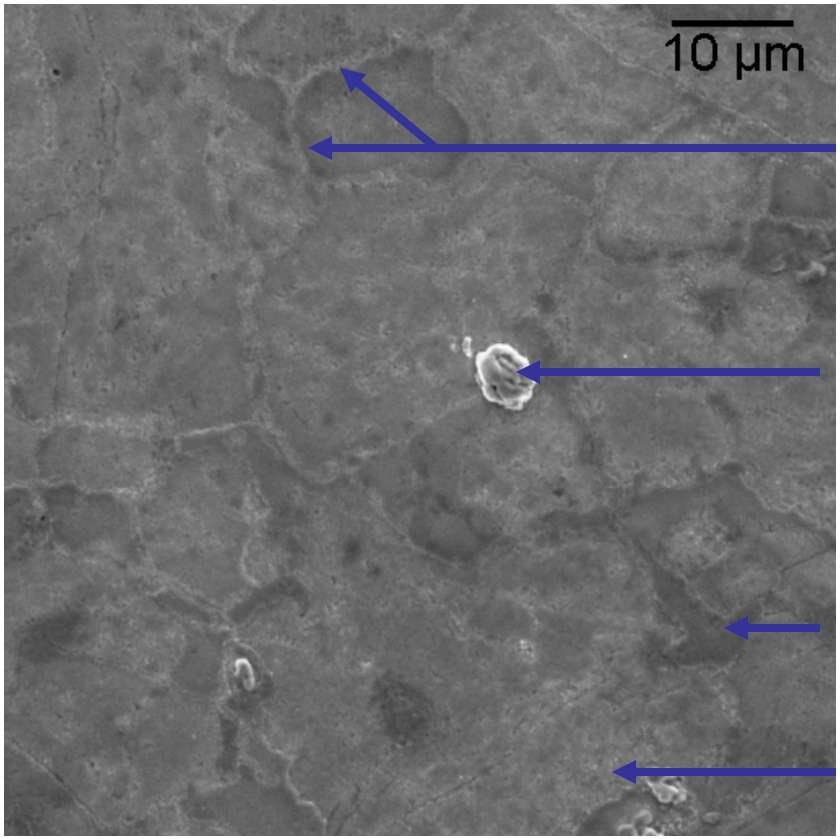
SLAC: CuZr Samples H2
Fired to 980°C: Top Side

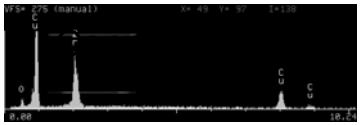




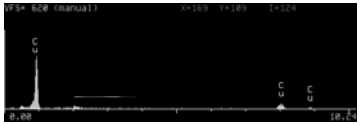




Strong Zr

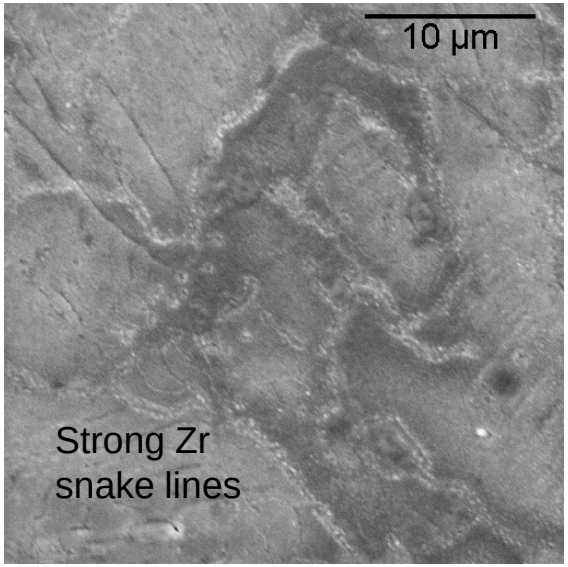


Copper only



Copper only

Weak Zr



Bot

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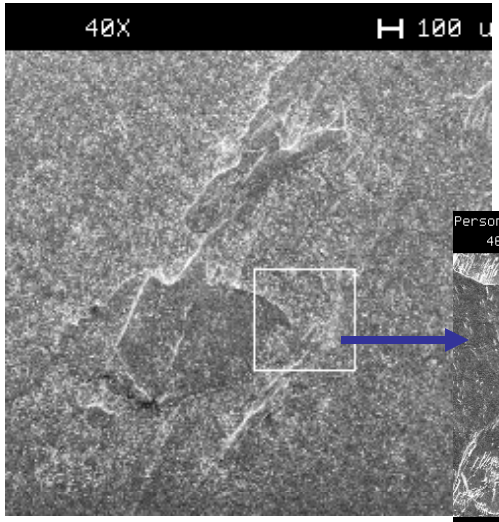
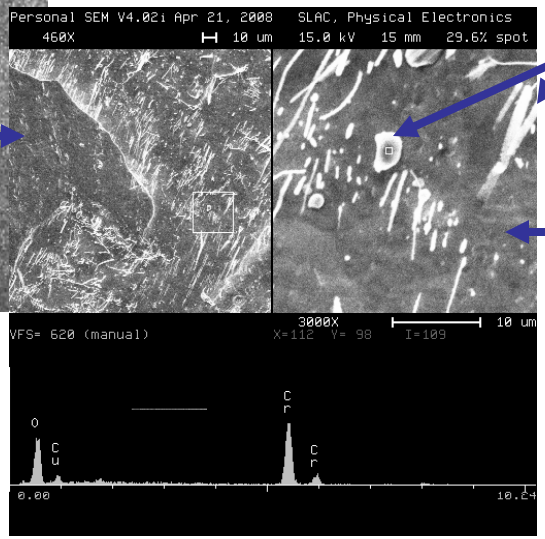
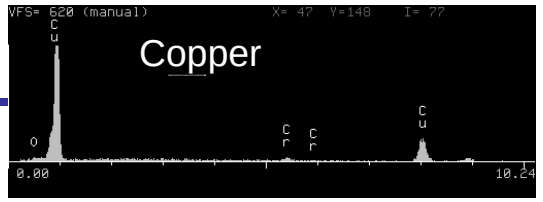
Copper Chromium (A)

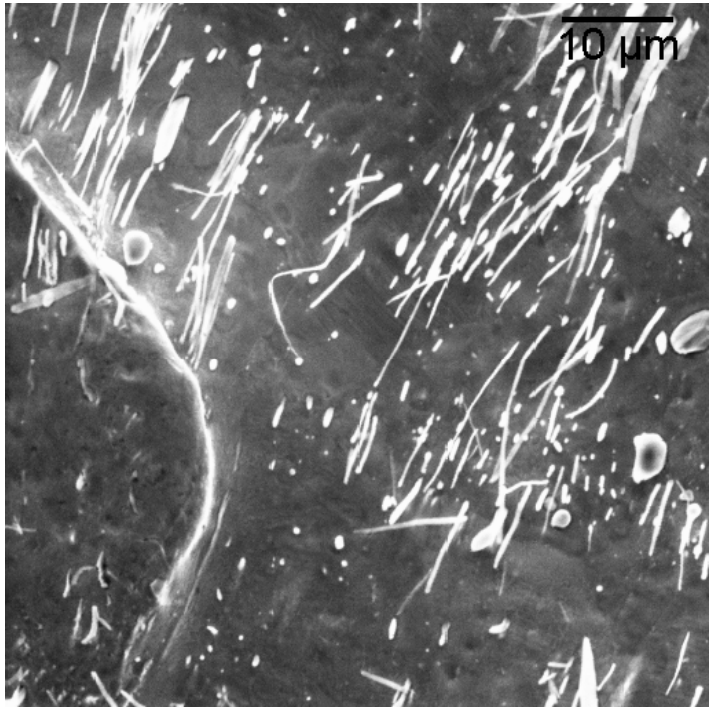
SEM Images: No Heat Treatment

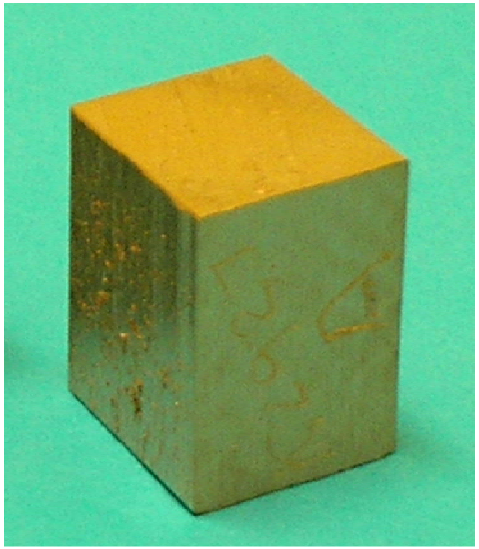




Chromium







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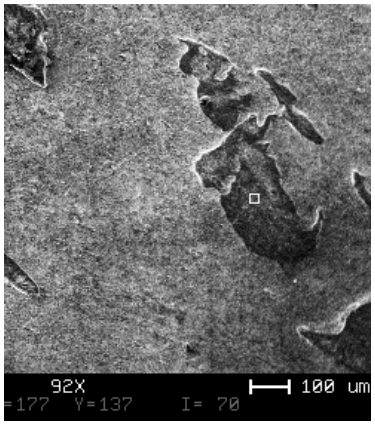
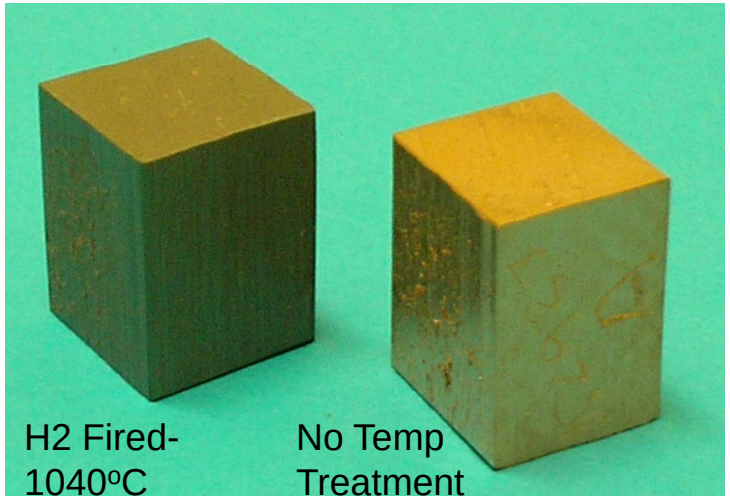
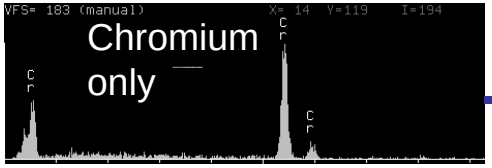
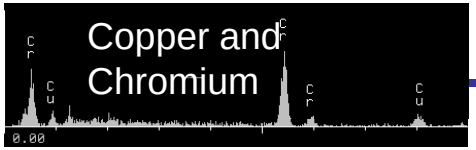
Copper Chromium (B) – H2 Fired at 1040°C

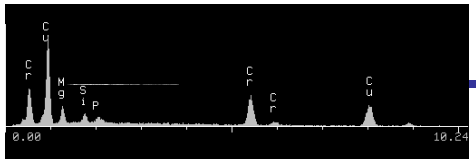


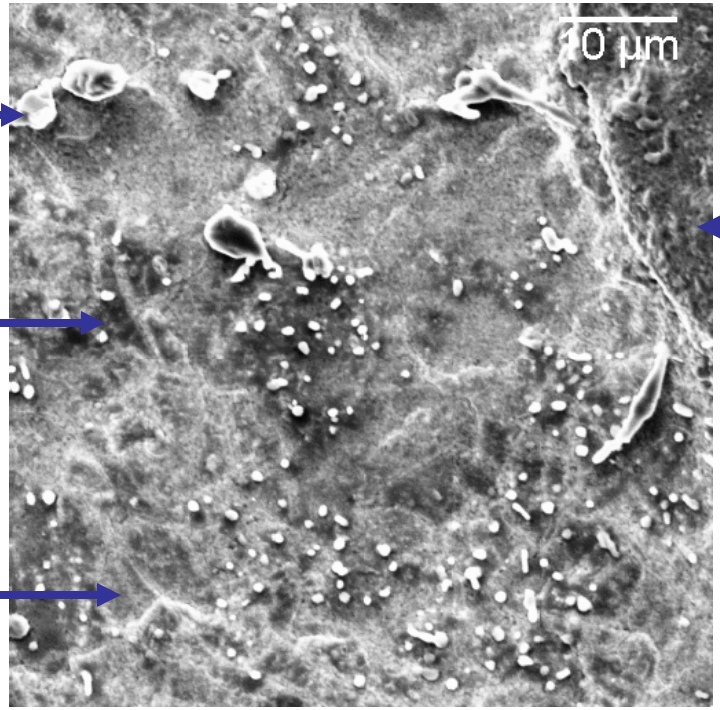




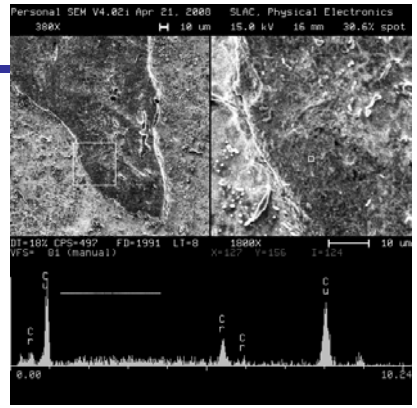


Cu, Cr, Mg, Si, P





Mostly Copper



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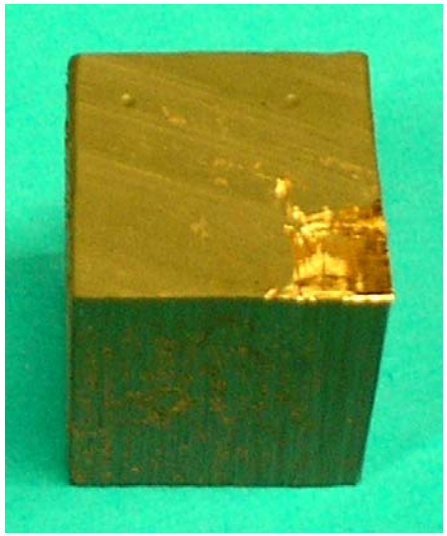
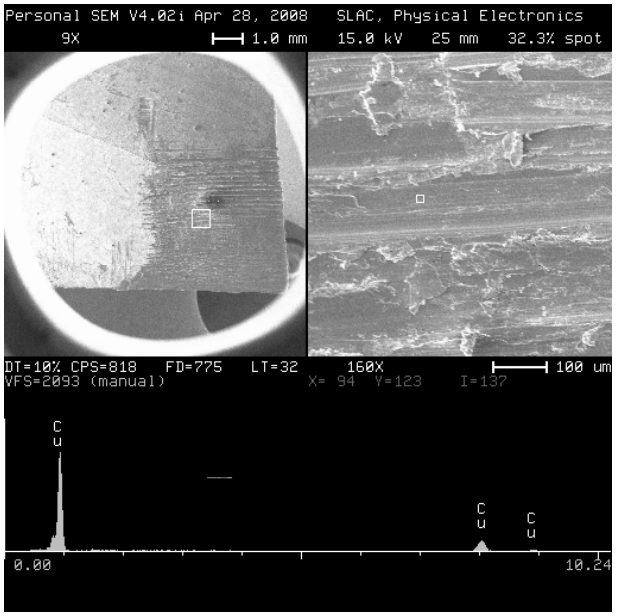
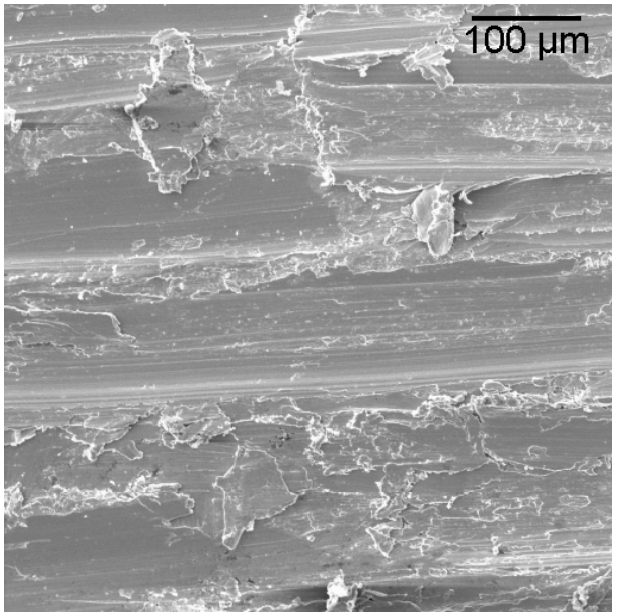
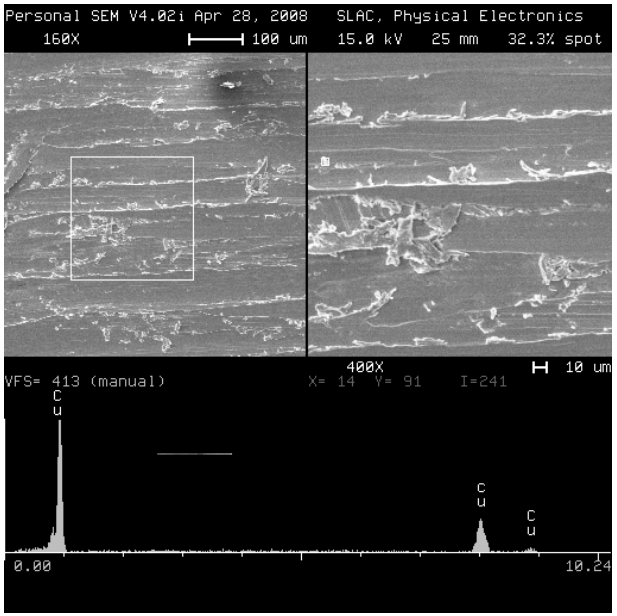
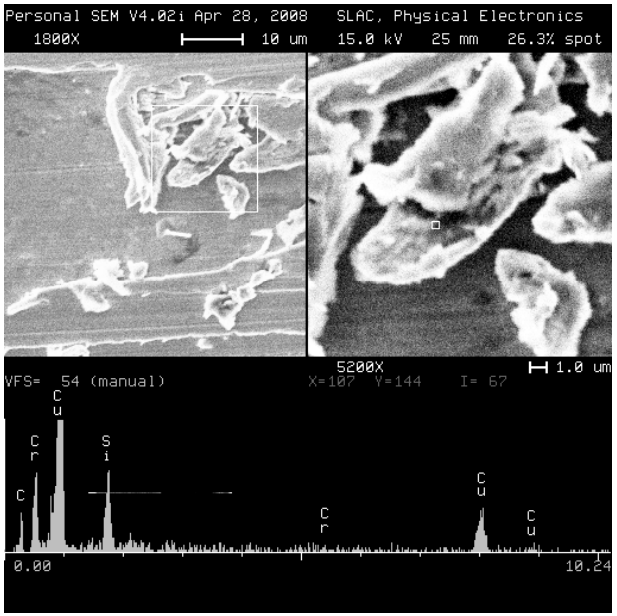
SLAC: CuCrB H2 Fired at 1040°C











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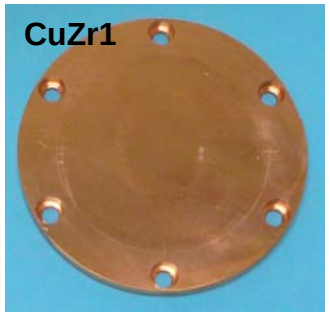
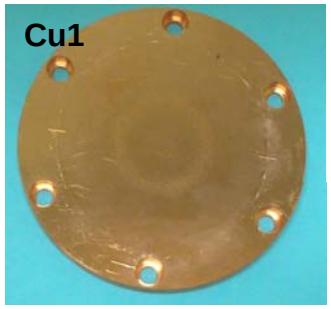
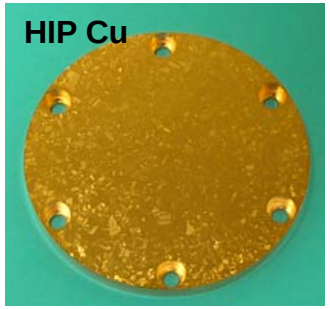
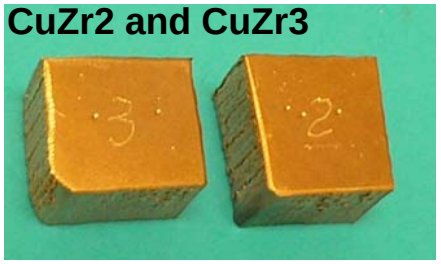
Hardness Test Measurements (Units are all HR15T)										
Pulse Heating Samples				Copper Coupons			CuZr and CuCr Cubes			
Cu1	CuZr1	CuZr2	HIP Cu	Cu406	Cu409	Stock Cu	CuZr1 Cube	CuZr2 Cube	CuZr3 Cube	CuCrA (NF)
78.78	59.00	58.00	26.95	81.25	81.30	79.45	84.00	85.50	85.05	86.50
			Etched	H2 Fired (1040°C)				Etched		CuCrB Fired
			28.45	11.25	10.50	16.10		85.25	85.90	47.25
								H2 Fired (980°C)		
								44.23	44.05	
									Age Hardened	
									(550°C/3hrs)	
									49.6	





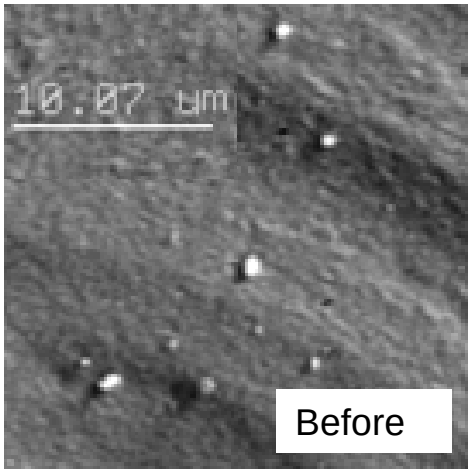


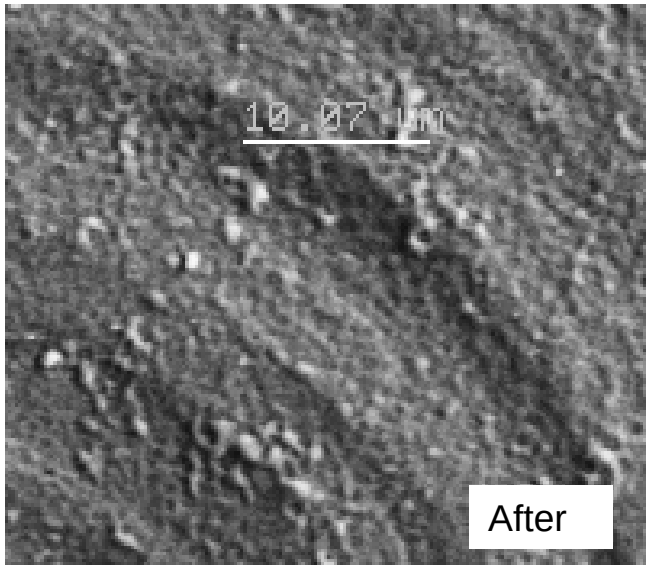


Can higher gradients be achieved with Cu Alloys or other materials that may offer some beneficial rf attribute and have all these particles on the surface?

GLIDCOP ®

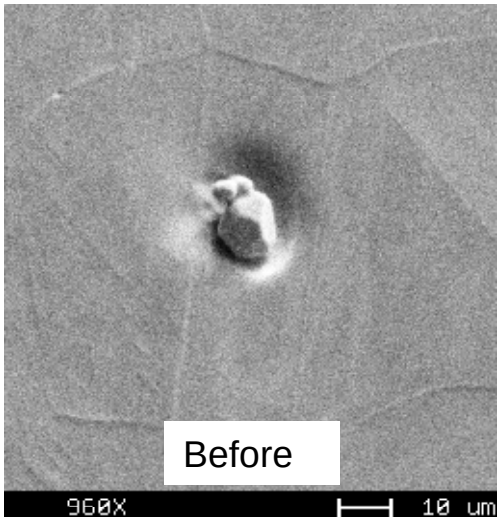
Same area before and after rf test (200 MV/m)

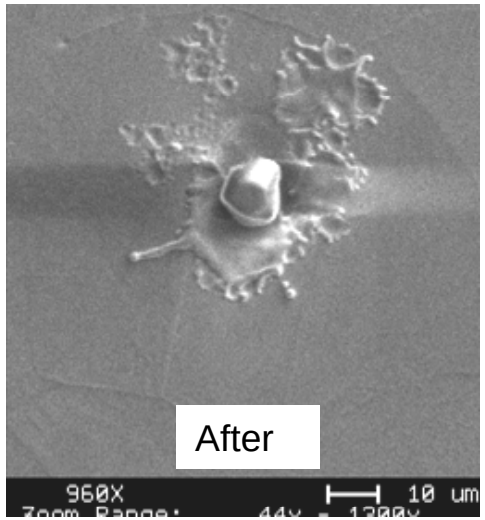




Electropolished Stainless Steel

Same alumina particle before and after rf test (200 MV/m)





Another alumina particle