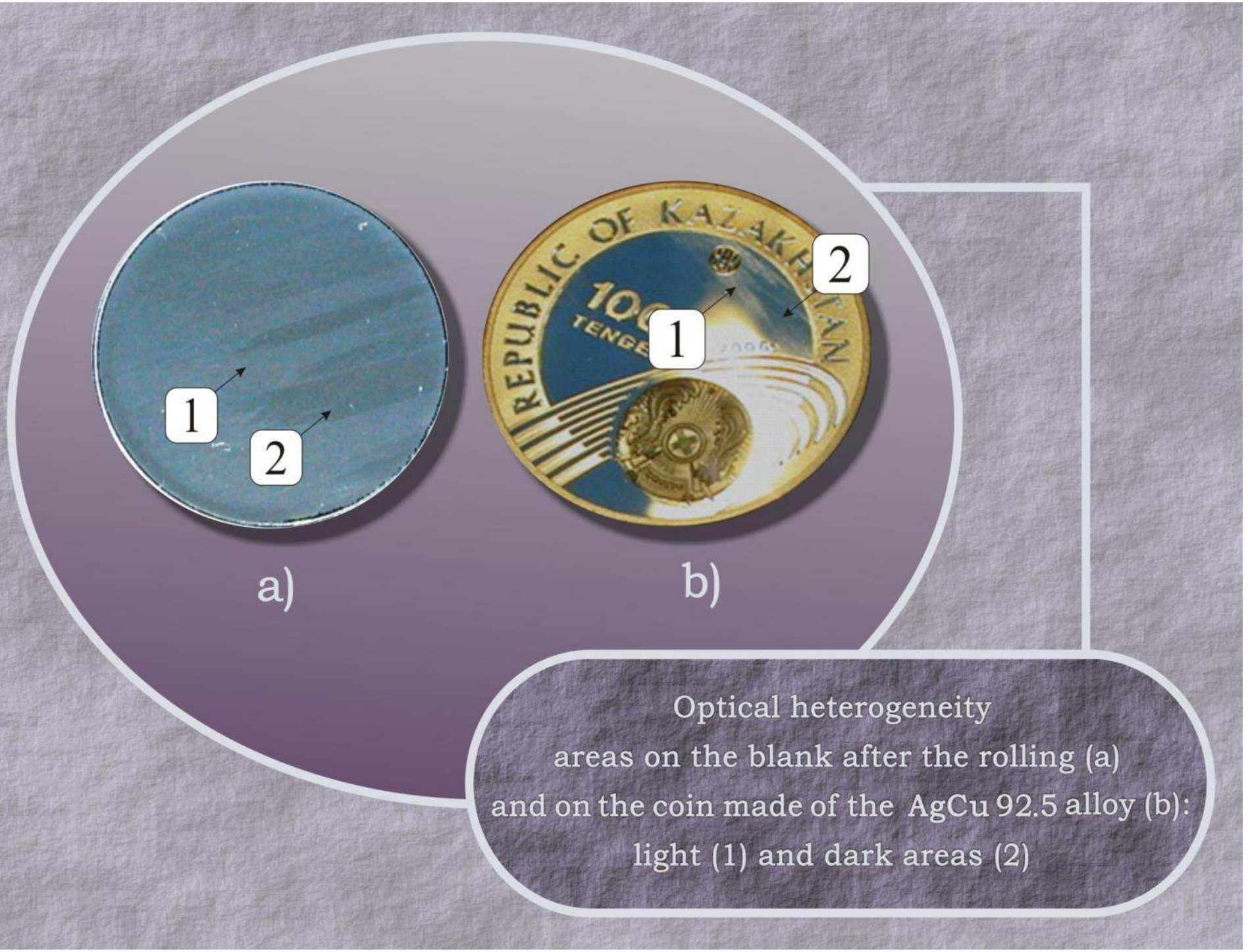
KAZAKHSTAN MINT IN COLLABORATION WITH EAST KAZAKHSTAN STATE TECHNICAL UNIVERSITY

THE RESEARCH OF THE FORMATION CONDITIONS OF THE "OPTICAL HETEROGENEITY AREAS" DEFECTS ON THE COINS MADE OF THE AgCu 92.5 ALLOY





Optical heterogeneity
areas on the blank after the rolling (a)
and on the coin made of the AgCu 92.5 alloy (b):
light (1) and dark areas (2)

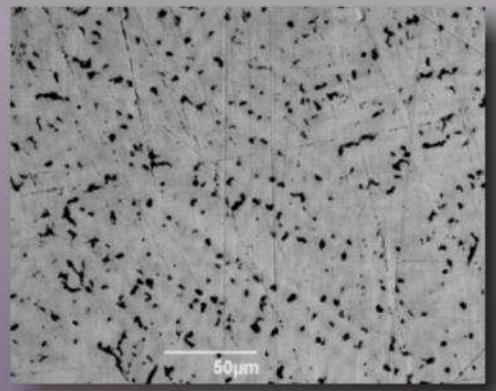
Goal of research: to determine the AgCu 92.5 alloy ingots crystallization rate conditions effects on the mechanical-and-physical properties of the coin blanks. Particularly: the impact on the alloying component state – copper; macro- and microstructure;
optical properties of the coin blanks surface.

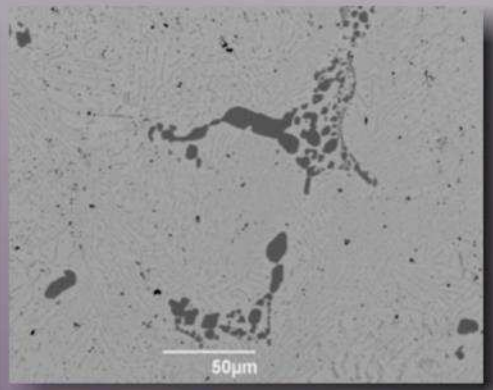


a) b)

Macrostructure of the AgCu 92.5 ingot, obtained by rapid (a) and slow (b) cooling

2 ingots of the AgCu 92.5 alloy at the cooling rate of 50 and 0.5°C/sec were obtained for research.
Research results
Macrostructure examination
("Axiovert 200 MAT" optical microscope).



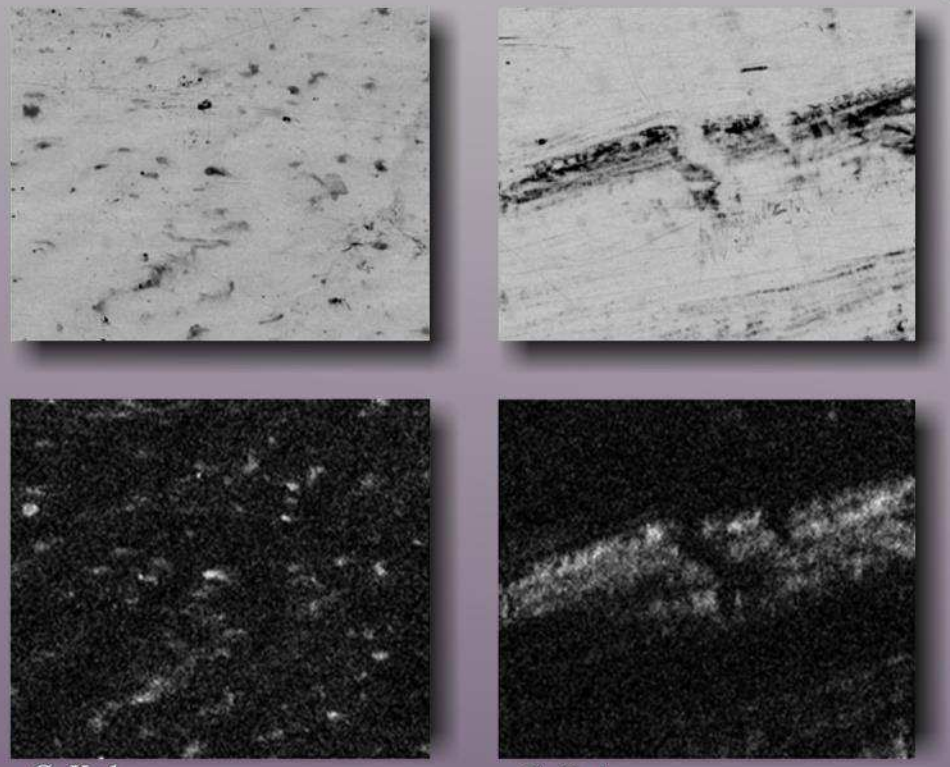


a) b)

a – rapid cooling, average area of β-phase is 16 μm^2

b – slow cooling, average area of β-phase is 840 μm^2

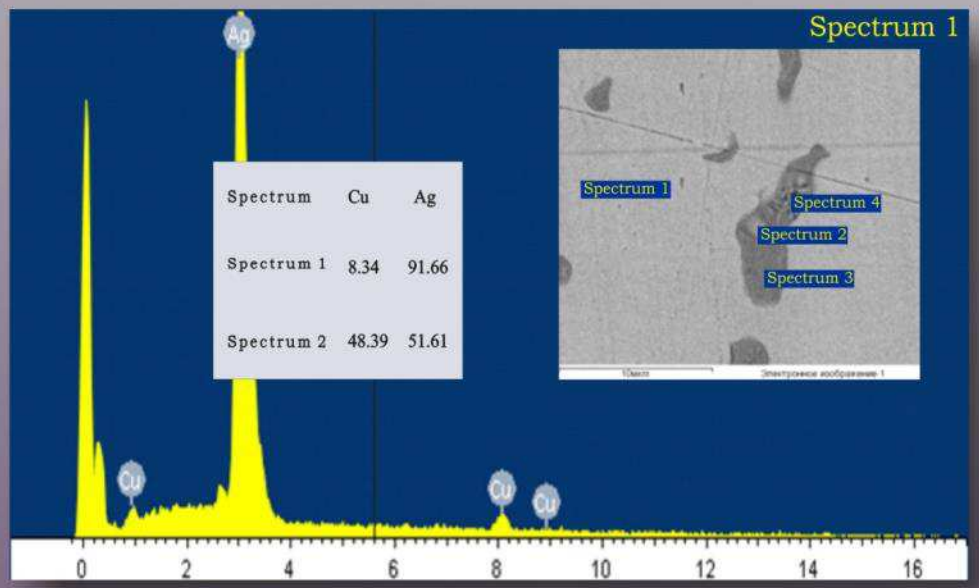
The results of qualitative microanalysis (JSM - 6390 LV electron-scan microscope microanalyzer) The β-phase sizes for the AgCu 92.5 alloy samples at the cooling rate of 50 and 0.5°C/sec were studied.



a) b)

Electronic image of the copper distribution
(light area on the dark background)
in the structure after the ingot rolling with rapid (a)
and slow (b) cooling

Quantitative microanalysis results (JSM - 6390 LV electron-scan microscope microanalyzer)

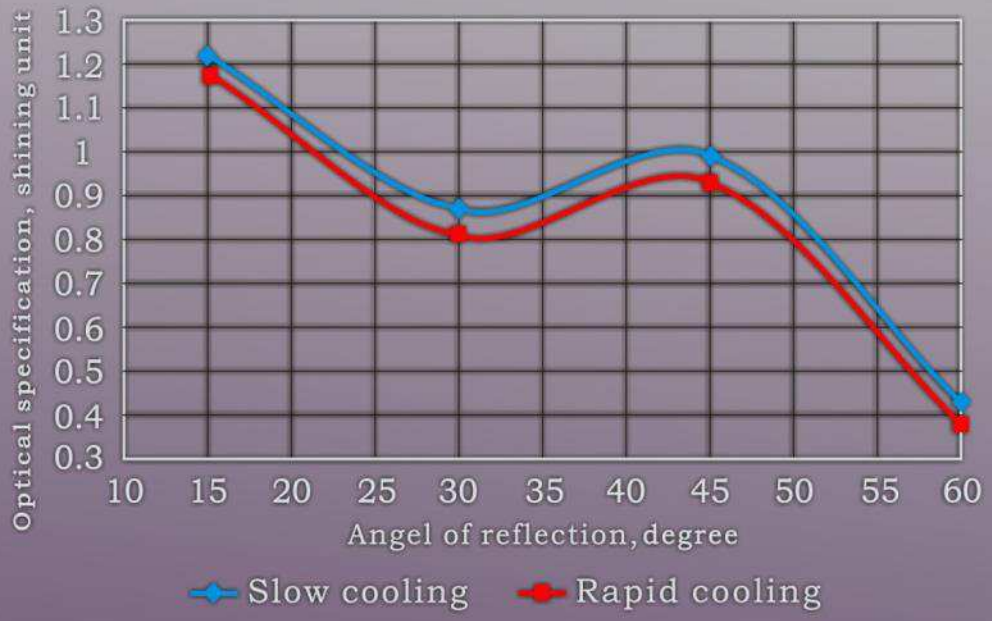


Copper content in the
α-solid solution (spectrum 1)
and β-solid solution (spectrum 2)
of the rapid cooled **AgCu** 92.5 alloy.

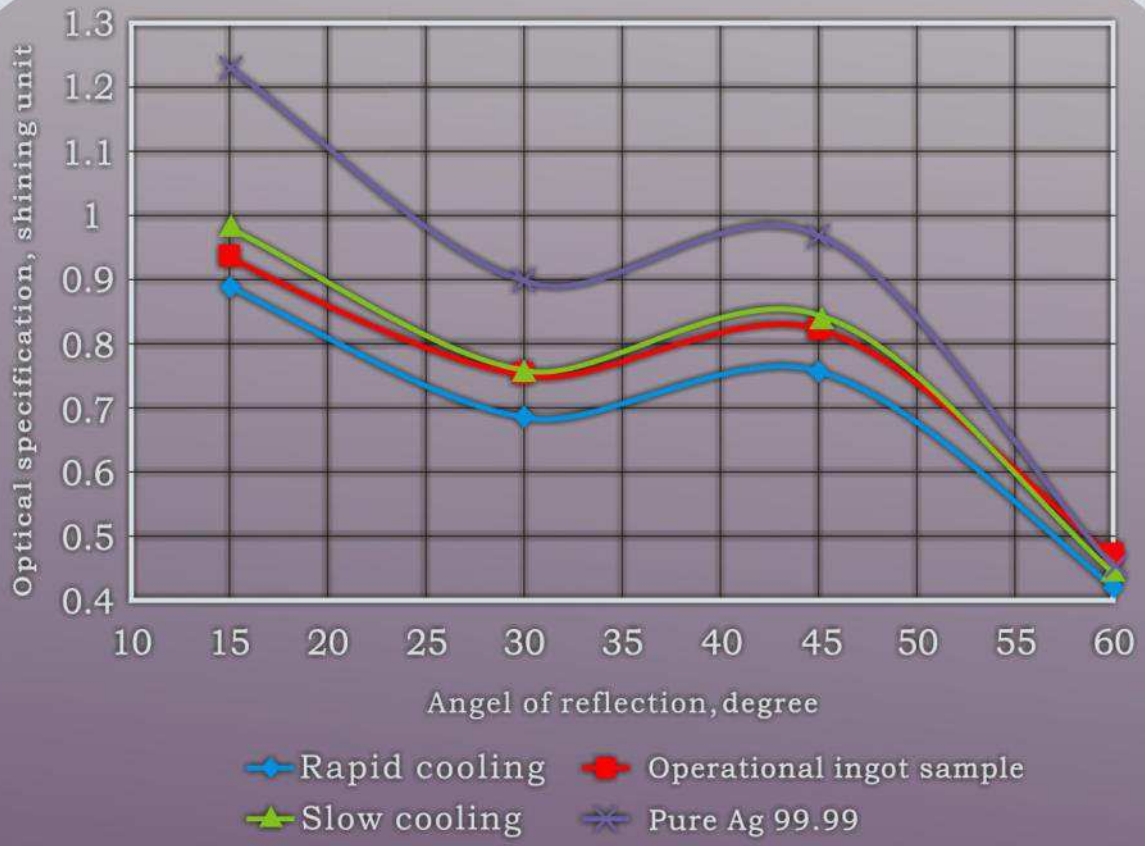
Rapid cooling %mass	Slow cooling %mass
8.34	2.81
9.01	3.24
5.51	3.66
Average value 6.98	Average value 3.23

Copper content in the α-solid solution of the AgCu 92.5 alloy depending on the ingot cooling rate

The research results for optical specifications of the AgCu 92.5 alloy samples (IBP-2 device)



Optical specifications of the AgCu 92.5 alloy ingot samples with various cooling rate

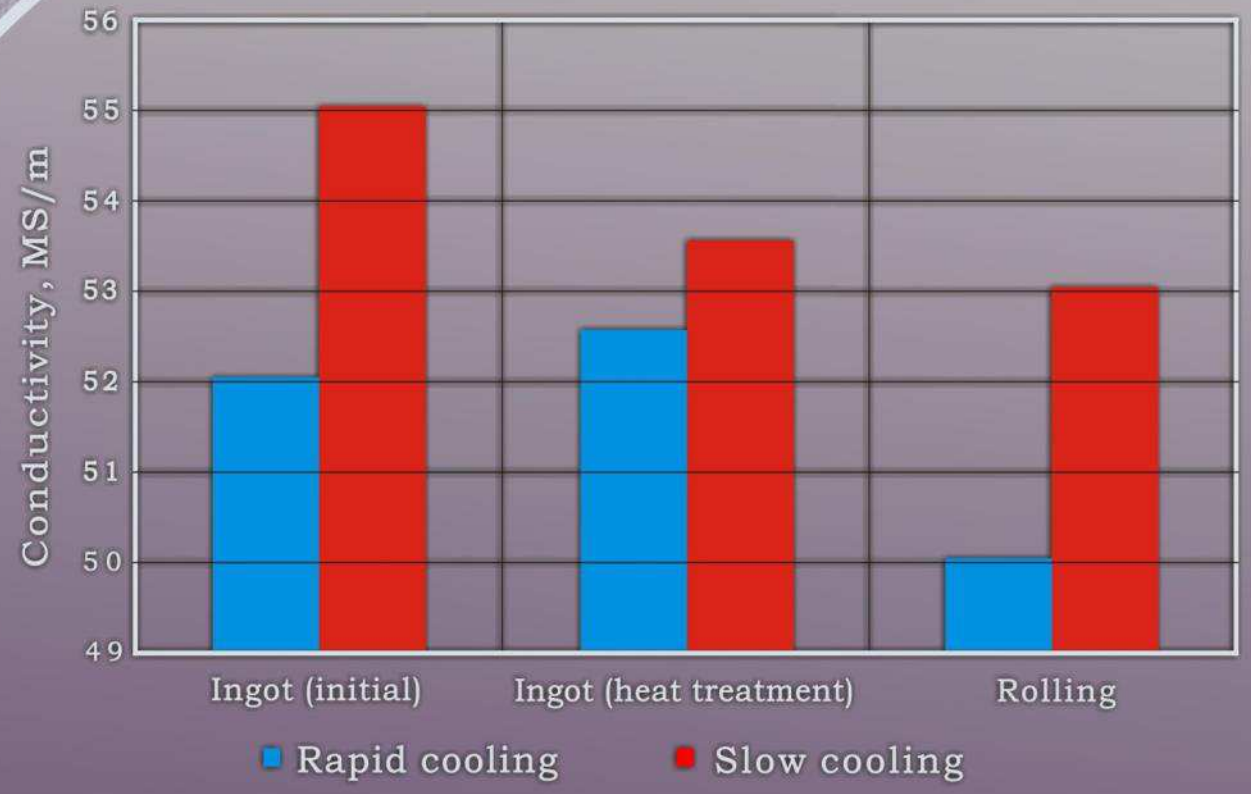


Optical specifications of the rolling surface of 2.62 mm in thickness depending on composition and crystallization rate

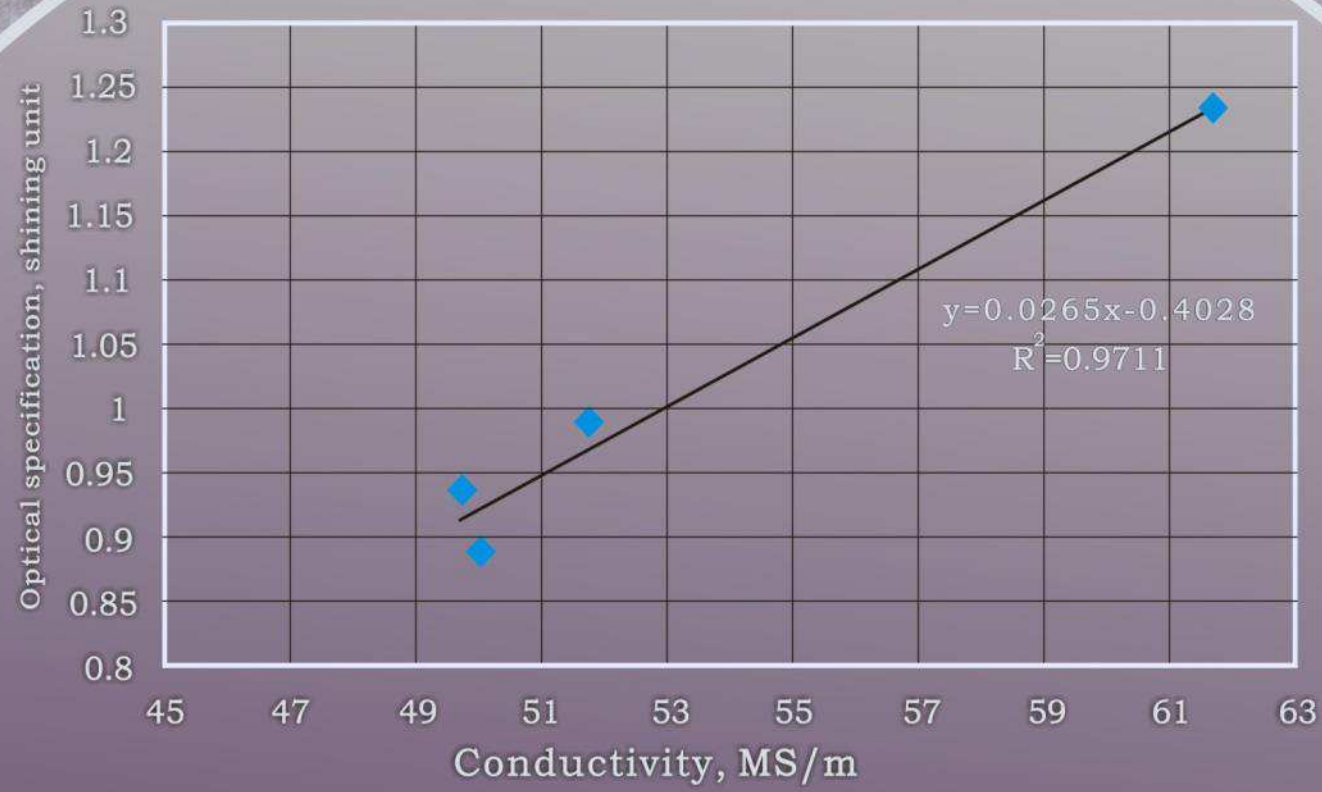
Conductivity research for the AgCu 92.5 alloy samples
(SIGMASCOPE SMP 10 device with determination error of 0.06 MS /m)

Ingot (initial)		Ingot (after heat treatment)		Rolling of 2.62 mm in thickness	
Slow cooling	Rapid cooling	Slow cooling	Rapid cooling	Slow cooling	Rapid cooling
55	52	53.5	52.5	53	50

Research results for conductivity
of the AgCu 92.5 alloy, MS/m



The AgCu 92.5 alloy conductivity depending on crystallization rate and the type of the heat and mechanical treatment



Dependence of the shining indexes (angle of refraction – 15°) of the rolling samples made of silver alloys on their conductivity

CONCLUSION

So laboratory experiments showed that:

1) Various cooling rate conditions at crystallization of the AgCn 92.5 alloy (cooling rate 0.5 and 50 °C/sec) provide chemical and structural heterogeneity:

- alloying component (copper) content in the solid α-solution changes from 5…9 % (rapid cooling) up to 2.8…3.7 % (slow cooling);
- average area of the β-phase precipitations at slow cooling makes up 840 μm^2, and at rapid cooling – 16 μm^2;

2) The alloy chemical and structural heterogeneity, caused by various crystallization rate conditions, leads to inequality of series of mechanical-and-physical and electrophysical properties:

- conductivity of cast alloy may differ by 5…6 %;
- optical specifications (shining) of the blanks surface may differ by 10 %.



CONCLUSION

3) Structural features, obtained at the ingot crystallization, are kept during further heat and mechanical treatment.

4) Inequality of mechanical-and-physical and electrophysical properties in various microscopic volume of the AgCu 92.5 alloy, creates opportunities for:

- appearing of optical heterogeneity areas on the AgCu 92.5 alloy blank surface;
- forming of «orange peel» and «uncoinage» defects in separate places.

5) Correlation relationship has been established between studied mechanical-and-physical properties. It allows considering the conductivity measuring procedure as a nondestructive control method for estimating heterogeneity of structure and mechanical-and-physical properties of the AgCu 92.5 alloy blanks.



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Thanks for your attention!