Influence of thermomechanical processing parameters on tensile strength of cast copper wire

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Abstract

In this paper, a copper wire with an initial diameter of 8 mm produced by the upcast process was used. The obtained wire is subjected to drawing, whereby the obtained (final) dimensions were: Ø 2.4 mm (degree of deformation ε = 91%), Ø 1.8 mm (degree of deformation ε = 95%) and Ø 0.8 mm (degree of deformation ε = 99%). Cut samples with a length of 30 cm were annealed, cooled in water and finally subjected to tensile strength determination. Annealing was performed in a very high purity nitrogen atmosphere at temperatures of 400, 500 and 600 °C for 2, 4 and 6 times the time for which the semi-recrystallized structure is obtained. Due to the greater accuracy of the results, three repetitions of the experiment were performed. In the case of 2.4 mm diameter samples, the tensile strength decreases slightly with increasing annealing temperature, at annealing times 2x and 4x the time for which the semi-recrystallized structure is obtained, while during 6x the time of semi-recrystallization it is approximately constant. For samples with diameters of 1.8 mm and 0.8 mm, a slight increase in tensile strength with increasing temperature is observed, and this increase is more pronounced with shorter annealing times and with a wire with a diameter of 0.8 mm.

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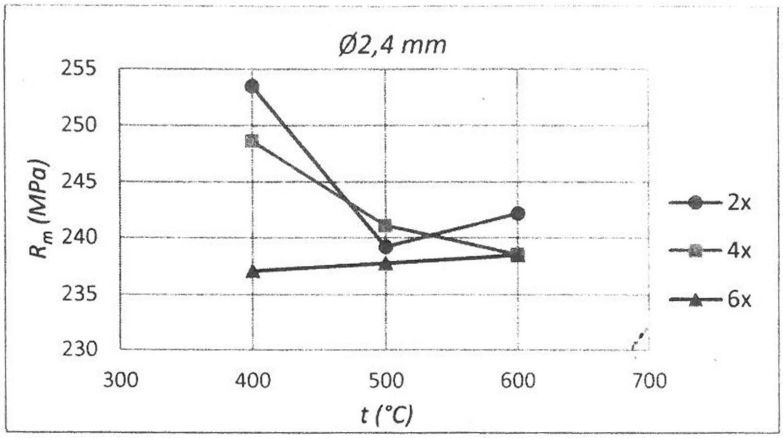
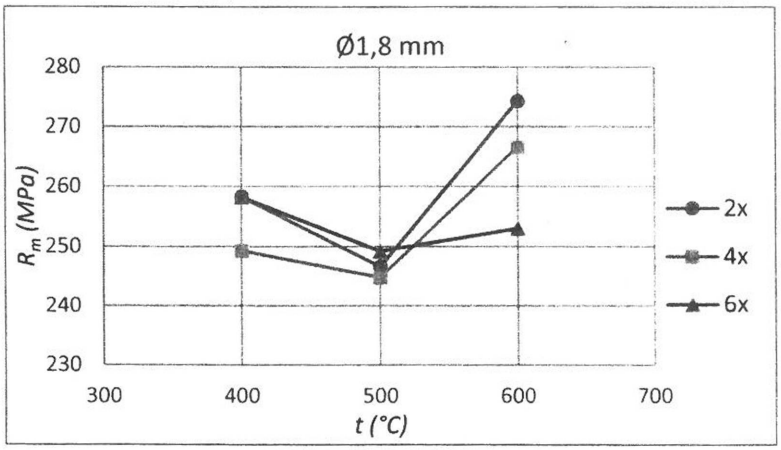
References

[1] X. Fu, R. Wang, Q. Zhu, P. Wang and Y. Zuo, Materials 2020, 13, 369
[2] M. Smolka, C. Motz, T. Detzel, W. Robl, T. Griesser, Rev. Sci. Instrum. 83 (2012) 064702
[3] S. Ivanov, D. Marković, L. Stuparević and D. Gusković, Bull. Mater. Sci., 19 (1996) 131-138
[4] D. Gusković, B. Stanojević, S. Stević, Savremeni postupci dobijanja bakarnih žica, Bor (1997)
[5] Đ. Drobnjak, Fizička metalurgija, Fizika čvrstoće i plastičnosti I, TMF Beograd (1981).
[6] M. Nairn, Technical Seminar organized by Indian Copper Development Centre, November 2014

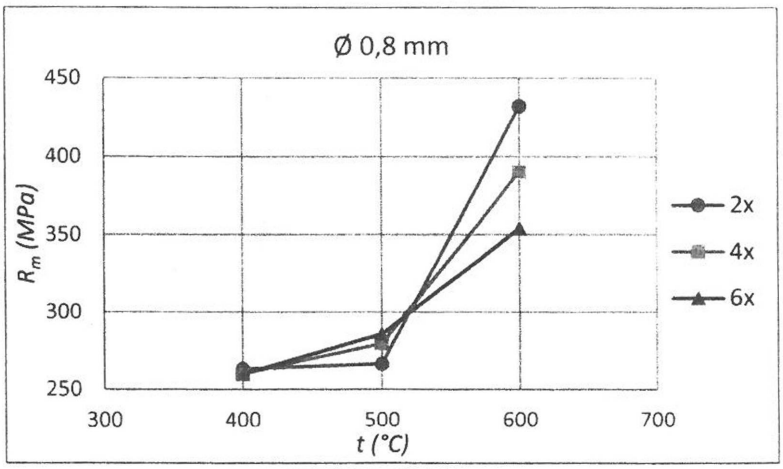
Graphical abstract:



Dependence of tensile strength on temperature and annealing time for wire Ø 2.4 mm



Dependence of tensile strength on temperature and annealing time for wire Ø 1.8 mm



Dependence of tensile strength on temperature and annealing time for wire Ø 0.8 mm