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Modifying of copper alloys using fine-grained modifiers on the basis of Al-Zr

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One of the promising areas for further improvement in copper alloys performance is its modification by fine-grained intermetallic compounds – products of the interaction of aluminum with transition and rare-earth metals (Cr, Fe, Mn, Zr, Sc, Y, etc.) [1]. A modification effect associates with the structure refinement of alloys. The cooling rate also effects on the size of structural constituents during crystallization.

In this work we studied the complex action of modification and cooling rate on the structure of brass Cu₁₀Zn and aluminum bronze Cu₁₄Al₄Ni by a cooling curves recording. The melt was alloyed by Zr using an addition alloy Al_{2,5}Zr, where Zr is bound into metastable intermetallic compound Al₃Zr. The submicron size intermetallic compound Al₃Zr has cubic lattice parameters which are very close to the lattice parameters of aluminum solid solution.

The liquid metal was poured into three forms having a different thermal conductivity. Analysis of the cooling curves showed that the cooling rates remained at the same level for the modified and unmodified alloys (64.4 K/sec for graphite form, 8 K/sec for fluoroflogopite form and 1.4 K/sec for quartz form). There were differences – the absence of overcooling and the shorter crystallization range of the modified alloys. This means that the intermetallic compound Al₃Zr creates a large number of crystal nucleus, removes the overcooling and reduces a crystallization time of the melt. The grains size of brass Cu₁₀Zn was reduced about three times after modification. As compared with brass, the effect of the aluminum bronze Cu₁₄Al₄Ni modification was more noticeable and the grains size was reduced in tenfold compared with the unmodified alloy and it was especially seen after hardening. Thus the developed alloy Al_{2,5}Zr has an positive effect on the structure of the investigated copper based alloys and can be recommended for use.

1. *Верховлюк А. М., Щерецький О. А., Левченко Ю. М., Сергієнко Р. А. Модифікатори на основі Al-Zr для алюмінієвих розплавів // Металознавство та обробка металів. - 2013.-3(67).-С.49-56.*