ON THE KINETICS OF DISINTEGRATION OF AN ALLOY OF COPPER WITH 5.5 ATOMIC PERCENT OF Mg UPON NATURAL AGING (FROM DIFFUSE SCATTERING OF X-RAYS BY POLYCRYSTALS)

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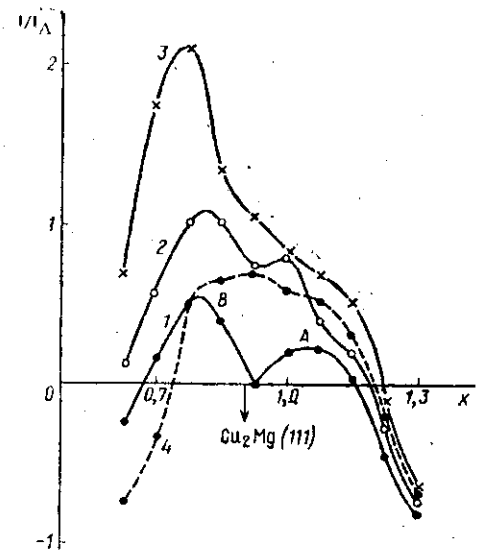
We have previously communicated [1] that it is possible to observe the disintegration of a solid solution by observing the X-ray diffusion pattern produced by polycrystals. In particular, it was found in investigating an alloy of copper with 4.5 atomic percent of Mg, quenched from 600°C, and held for a long time at room temperature [1], that a diffusion maximum appears near the angle corresponding to the first (111) line of the Loves phase Cu_2Mg [2,3]. This indicated that the alloy contained nuclei of Cu_2Mg, which precipitate at temperatures (<500°C), corresponding to the limit of solubility of Mg in Cu, which is less than 4.5 atomic percent.



Curves of the intensity of diffusion scattering of an alloy of copper with 5.5 atomic percent of Mg: curve 1 was taken on the day after annealing; curve 2 was obtained 3 days after annealing; curve 3 - 6 days after annealing; curve 4 - 20 days after annealing; $x = 2a \sin\vartheta/\lambda$, a is the lattice parameter of the matrix, I/I_Λ is the intensity of diffuse scattering refereed to the Laue background.

To investigate the initial stages of natural aging, we performed another series of experiments with an alloy of close composition (copper with 5.5 atomic percent of Mg), quenched into vaccum oil after two-hour anneal at 600°C, and held for different time intervals at room temperature. The intensity of diffuse scattering of X-rays was measured 1, 2, 3, 5, 6 and 20 days and 10 months after annealing.

Already on the day following the annealing the intensity curve (curve 1 in the figure) contains two diffusion maxima: maximum A at large angles, corresponding to the close order in the solid solution, and maximum B, shifted in the direction of smaller angles relative to the location of the (111) line of Cu_2Mg. The heights of both maxima grow over a week, and they merge (curves 2 and 3). Then 20 days later maximum B is observed to drop again significantly, virtually

until it vanishes entirely (curve 4). Curve 4 depicts in fact only one wide maximum with its center near the (111) line of Cu_2Mg, slightly elongated in the direction of the near-order maximum. The measurements performed 10 months after annealing show that the intensity of diffuse scattering increases approximately three fold and clustered into a highly smeared out maximum, lying in the same region (these measurements are not shown in the figure).

The above data indicate that during the first days after annealing there precipitate nuclei of a certain, apparently metastable, phase which upon subsequent holding at room temperature, begin to undergo resorption, and virtually vanish within as little as 20 days. They are replaced by nuclei of the stable Cu_2Mg in the finely-dispersed state.

These results also allow the conclusion that disintegration in certain solid solutions can be investigated not only with monocrystals, but also with polycrystal specimens, by measuring the intensity of diffuse scattering of X-rays and by processing the resultant data by the same method which is usually used in investigating the near order [4].

REFERENCES

1. Ya. I. Graevskaya, A. P. Zvyagina, and V. I. Iveronova, "Rate of diffuse scattering of X-rays by polycrystals of solid solutions with nuclei of a precipitating phase," Fiz. met. i metallovedenie, vol. 44, pp. 209-212, 1977.
2. M. Yu. Teslyuk, Metallic Compounds with Loves Phase Structures [in Russian], Moscow, pp. 10-15, 1969.
3. G. V. Reinor, Metal Science of Magnesium and Its Alloys [in Russian], Moscow, 1964.
4. V. I. Iveronova and A. A. Katsnel'son, "The Close Order in Solid Solutions [in Russian], Moscow, pp. 91-95, 1977.

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