

SHORT REPORTS AND LETTERS TO THE EDITOR
 INFLUENCE OF PRESSURE ON THE MUTUAL DIFFUSION OF METALS STUDIED
 IN CONNEXION WITH THE APPEARANCE OF DIFFUSION POROSITY*

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1. The high-temperature annealing of crystalline solids in which there are excess vacancies or a vacancy "source" is known to lead to the formation of what is known as diffusion porosity [1]. In [2] it was found experimentally that external volumetric compression does affect the process of the nucleation and development of pores of diffusion origin. Moreover it was found that comparatively small pressures, of the order of σ/L (σ is the specific surface energy of the crystalline solid and L is the mean linear dimension of nucleating microcracks), will prevent the formation of pores, while at $P \sim 10^{-10} \text{ kg/cm}^2$, which corresponds to the reasonable value $L \sim 10^{-4} - 10^{-5} \text{ cm}$, practically no diffusion porosity will arise. This has been confirmed experimentally in works where the mutual diffusion [3] and processes of the high-temperature annealing of defects has been studied in single crystals [4, 5].

The present work was undertaken with the aim of obtaining further information on this effect, particularly that which would emerge from a comparison of metallographic data and data on the microhardness distribution in the diffusion zone of specimens.

2. In the experiments described below single-phase brass type L-70 and technically pure copper were used. The diffusion equalisation of the zinc concentration in a brass-copper system is known to be accompanied by the development of diffusion porosity in the brass (see [1]).

The specimens were prepared as follows. Into a copper tube which had been carefully annealed and etched in nitric acid a brass wire was inserted after it had first been freed of various kinds of surface inclusions and oxides by mechanical polishing and etching in a solution of ammonium persulphate in ammonia. A really reliable and sensitive contact

between the brass and copper was achieved by drawing the copper tube with the brass core through a set of wire dies. The wire produced in this way was cut up into specimens 10 mm long and 1.5 mm in diameter.

The specimens were given a diffusion annealing in an autoclave with a volume of 20 cm³ in an argon atmosphere 99.99 per cent pure. The autoclave was designed [6] so that the pressure in the working chamber could be varied from 1 to 100 atm. The temperature was adjusted and maintained by a two-position electro-mechanical heat regulator with an accuracy of $\pm 2^\circ\text{C}$. A chromel-alumel thermocouple was used as the temperature pickup.

The experiments consisted in the following. Specimens produced as described above were given an isothermal anneal at various different pressures. The anneal was carried out at 800° and pressures of 1, 10, 25, 50 and 100 atm. At each pressure the annealing time was varied from 0.5 to 19 hr. After each anneal a metallographic section was produced in the plane perpendicular to the axis of the specimen and the microstructure was studied. Fig. 1 shows typical structures of specimens which had been annealed for 6 hr at various different pressures. This collection of photographs provides qualitative confirmation of the effect of volumetric compression on the nucleation and development of pores which have arisen in the process of mutual diffusion. As with the earlier experiments [2], a pressure of $p \approx 10$ atm reduces considerably the development of the diffusion porosity. The slight quantitative differences in the effect of pressure in these experiments and those described in [2] may be due to the different purity of the brass. This would lead to different kinds of micro-imperfections which would become condensation centres for excess vacancies. If the linear dimension of this kind of imperfection is assessed by means of the obvious relation $r \approx \sigma/p^*$ (p^* is the minimum

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