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Microstructure Evolution of Discontinuous Precipitation and Coarsening of Co Rod-like Precipitates in Supersaturated Cu-Co alloys

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Discontinuous precipitation (DP) is a solid state reaction in which precipitation takes place in a moving interface, generally a moving, incoherent, grain boundary. The transformation product is arrays of precipitates growing cooperatively and perpendicular to the moving interface. Among hundreds of alloy systems in which DP takes place, Cu-Co alloy is of great importance due to ferromagnetic character of Co precipitates. In this alloy system, anisotropic arrangement of precipitates generates magnetic anisotropy and consequently drastic changes in its magnetic properties. It is known that in diluted Cu-Co alloys, DP takes place at relatively low temperatures, ranging from 450 to 700°C with Co rod-like precipitates coherent with the matrix [1]. However, interesting magnetic properties have been reported in supersaturated Cu-Co alloys in condition in which DP is the dominant mode of precipitation after isothermal aging treatments [2, 3]. For this reason, it is of fundamental importance to understand the development of DP and coarsening in Cu-Co alloys.

In this paper we investigated the growth of DP and coarsening in supersaturated Cu-10at. %Co alloys upon isothermal aging at temperatures ranging from 450 to 650°C, for periods of 5, 10, 30 and 60min. Due to nanometric size of precipitates (about 2nm in diameter), a TEM/STEM JEOL JEM 2100F operating at 200kV under conventional, scanning and analytical transmission electron microscopy was used to analyze the microstructure in detail. Nano beam diffraction (NBD) mapping NANOMEGAS technique has been used to evaluate orientation relationships between precipitate colonies and parent matrix as well as preferential directions of discontinuous reactions upon grain boundary migration.

Results show that DP was the dominant mode of precipitation. Discontinuous precipitates are rod-like Co-rich, fully coherent with matrix with fcc structure, as confirmed by diffraction patterns. We verified a good stability of these precipitates at 450°C up to 60min of aging, with DP development in all high angle grain boundaries. At higher temperatures, coarsening takes place rapidly consuming discontinuous precipitates. This coarsening is also grain boundary driven, so-called discontinuous coarsening (DC): the grain boundary moves consuming DP colonies replacing them by coarsen rod-like precipitates, with fcc structure and still coherent with matrix at early stages. However, under aging for longer periods of time DC precipitates lose coherency and change orientation in a similar fashion as demonstrated by Takeda for coherency loss of homogeneous Co precipitates [4]. Fig. 1a and b show well-defined DP and DC colonies respectively. Fig.2a shows the coherency loss of a rod-like DC precipitate by emission of dislocation loops, seen as the ring-like contrast. EDS Co mapping in Fig. 2b confirm the presence of precipitate phase β. After longer aging times, DC β precipitates become incoherent with the matrix α and change orientation adopting the orientation relationship $(100)_{\alpha}//(110)_{\beta}$, as can be seen in the NBD mapping in Fig.3.

References

[1] A. Perovic, G. R. Purdy, Acta Metall. **29**, (1980) 53.
[2]E. F. Ferrari, W. C. Nunes, M. A. Novak, J Appl. Phys. 86 (1999) 3010.
[3] N. M. Suguihiro et al. J. Mat. Sci. 49 (2014) 6167.
[4] M. Takeda et al. Phys. Stat. Sol. 168 (1998) 27.

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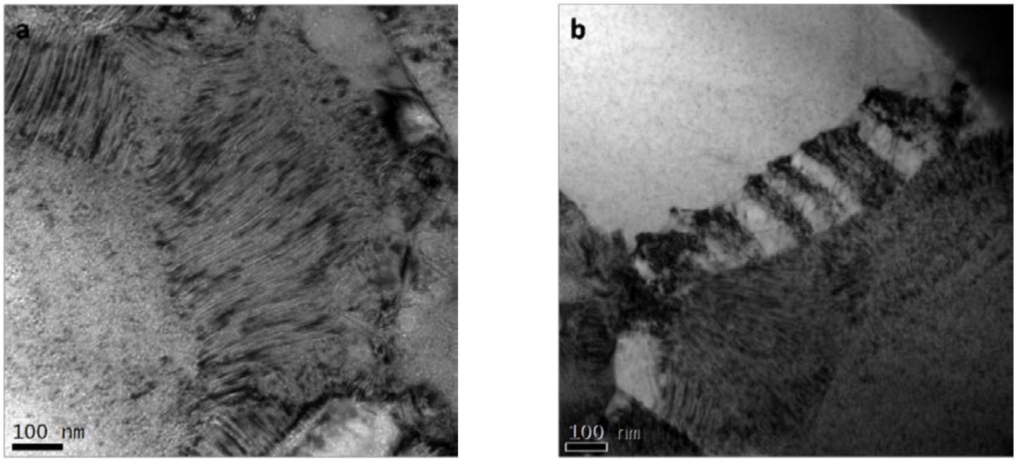

Figure 1 – TEM bright field images. (a) DP colony in sample aged at 550°C for 60min. (b) Discontinuous coarsening after 30min at 550°C.

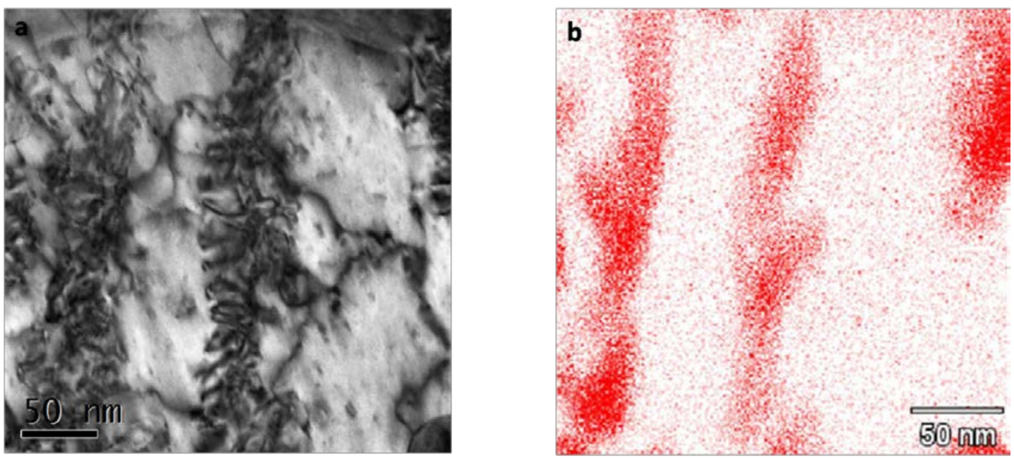

Figure 2 – (a) TEM bright field of semi-coherent DC after 60min at 650°C. (b) Corresponding EDS Co mapping.

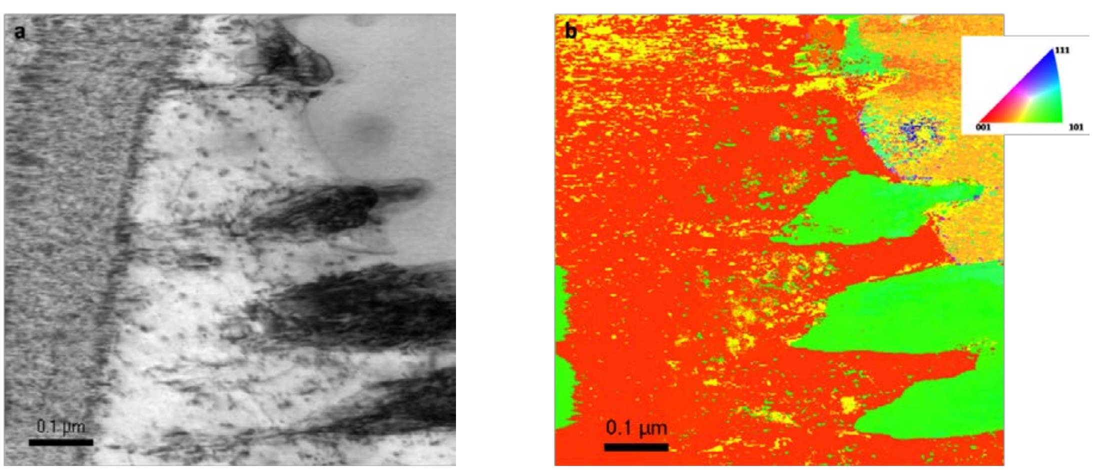

Figure 3 – NBD in a sample aged at 650°C for 60min. (a) Reconstructed bright field image. Notice the DC colonies, with precipitates with dark contrast. (b) Crystalographic orientation map.