The Sulfidation of a Cu–15 vol.% Nb Alloy in H₂–H₂S Mixtures at 400–600°C

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The corrosion of a Cu–15 vol.% Nb alloy by H₂–H₂S mixtures has been studied under 10⁻¹² atm S₂ at 400 and 500°C and under 10⁻¹⁰ atm S₂ at 500 and 600°C. The alloy is a two-phase mixture of the two terminal solid solutions and is composed of a Cu-rich matrix containing particles of the Nb-rich phase elongated parallel to the sample surface and isolated mainly from each other. The alloy corroded at rates similar to those of pure copper at 400 and 500°C under 10⁻¹² atm S₂, but more slowly than pure copper at 500 and 600°C under 10⁻¹⁰ atm S₂. The scales were duplex, containing an external layer of pure copper sulfide and an inner very porous region composed of a mixture of sulfides of the two metals in which, however, the core of the large Nb particles was still uncorroded.

KEY WORDS: niobium; copper; sulfidation.

INTRODUCTION

Two-phase alloys based on copper and containing a second nearly insoluble element, which is normally chromium, niobium or tantalum¹ (microcomposites), are interesting for high-temperature applications due to their high thermal conductivity and high strength.¹ These ductile composites are two-phase mixtures composed of a copper matrix containing filaments of the
second element obtained by means of appropriate deformation processes. The oxidation behavior of a Cu–15 vol.% Nb alloy in air at 600–900°C has been studied recently. The present paper reports the results of similar work on the sulfidation of the same material. This study is of interest in view of the very low reciprocal solubility of Cu and Nb and of the absence of intermediate phases in the relevant phase diagram. Moreover, the two metals have very different rates of sulfidation, while their sulfides have quite different thermodynamic stabilities. Thus, the sulfidation of Cu–Nb alloys is an interesting case of corrosion of two-phase materials at high temperatures, which has been frequently investigated in recent times both for their experimental behaviour and from a more theoretical point of view.

**EXPERIMENTAL**

A copper-base alloy containing about 15 vol.% Nb, corresponding to about 14.5 wt.% Nb (Cu–15Nb), was obtained from Rockwell International Corporation (California, U.S.). According to the relevant phase diagram (Fig. 1) copper and niobium are very slightly soluble into each other and