

RING WITH BUTTON

COMPOSITION: Copper-silver alloy (analysis unavailable)

MICROSTRUCTURE

SECTION A: Longitudinal section through the button, part of the stem, and the join between button and stem.

Photomicrographs

- A1 -This section, in the polished condition, shows the large, spherical pores that characterize the button portion of the object and which are randomly distributed throughout the button. In addition, a zone of very large and irregularly shaped pores occurs along the interface where the button and the stem join. Note the virtual absence of porosity in the metal of the stem [x22; Etchant: None-polished condition].
- A2 -This is the same section as shown in A1, after having been etched and photographed at a slightly higher magnification. The microstructure is distinctly different in three portions of the object: (a) the button, (b) the stem, and (c) the metal which forms the join between the button and stem [x25; Etchant: 10% CrO₃].
- A3 -Microstructure of the button: this is a typical, cast structure showing well-formed dendrites in various orientations. The primary dendrites (grey) are copper- rich and are surrounded by the Cu-Ag eutectic microconstituent (white). Note the large, spherical pores (black) distributed throughout the metal [x250; Etchant: 20% CrO₃].
- A4 -Microstructure of the join between the button and the stem: the upper half of the photomicrograph shows the structure of the button (same as in A3). The lower half of the photomicrograph shows the metal at the union between button and stem. The join metal is still an alloy of copper and silver and exhibits a cast structure; but the dendrites are much finer, indicating that the metal at the join cooled and solidified at a more rapid rate than the button metal. The porosity is also finer [x250; Etchant: 20% CrO₃].
- A5 -Microstructure of the stem: the alloy is again Cu-Ag, but the structure is no longer that of a casting. The primary dendrites (grey) are severely elongated and have lost their cast configuration. The dendrites and the eutectic microconstituent (white) are both strung out in long, semi-parallel bands along the length of the stem. Note the virtual absence of porosity in the stem metal [x250; Etchant: 20% CrO₃].

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INTERPRETATION OF MICROSTRUCTURE

The ring with button is constructed of two parts -- the button and the stem -- each of which was fabricated from a separate piece of metal. The two parts were later joined, to produce the object. Both the button and the stem are made of an alloy of copper and silver (analysis not available), and the metal which forms the join between them is also a Cu-Ag alloy.

The button was cast to its present shape. Its microstructure is typical of a casting with large, well formed dendrites. The spherical macropores in the button have resulted from the formation of bubbles in the molten metal as gases escaped through it as it cooled and solidified.

The stem, though made of the same kind of copper-silver alloy, has been worked to shape. The original piece of metal from which the stem is made was cast, and the microstructure reveals vestiges of the original dendrites. But the metal was later severely worked in order to shape the stem. Working plastically deformed the metal, causing it to flow as it was hammered. As a result, the dendrites have become severely elongated along the length of the stem, in the direction of metal flow.

Between the button and the stem there is a zone of metal--also a Cu-Ag alloy--which joins these two parts. This metal at the join was molten when it was introduced between the button and the stem and retains the fine dendritic structure of a metal that cooled fairly rapidly from the molten state. There are two ways in which the joining metal could have been introduced: (a) as a solder; (b) the tip of the stem may have been heated locally until it was molten or semi-molten --heated to a mushy condition-- then the tip pressed firmly onto the button. An analysis of the composition of the copper-silver alloy in each of the three parts of this object would help determine which of these two joining methods was used. If the joining metal is a solder, its composition should be different from that of the button and the stem, and its melting point should be lower than that of the other two alloys; if the join was achieved by locally heating the tip of the stem until it melted or almost melted, the composition of the joining metal and the stem metal should be identical.