Metallography of the Beaded Copper Conductors

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International Association of Arson Investigators Taiwan Chapter

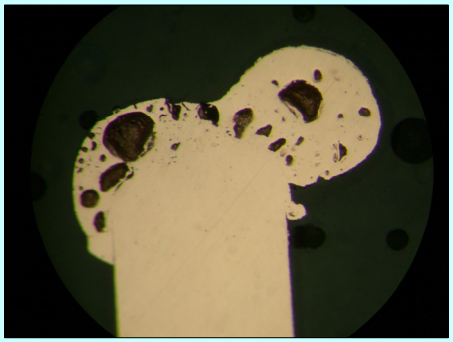

Figure 1. In extreme heat, some copper vaporizes and induces porosity within the bead. (5X)

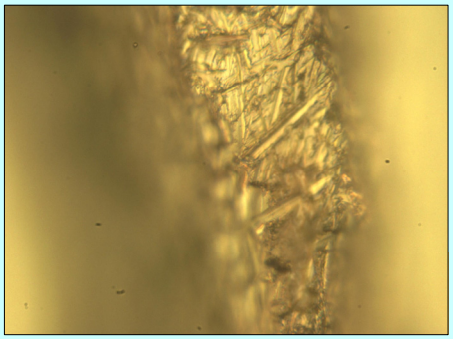

Figure 2. Crystalline solids form in the porosity of the bead. (500X)

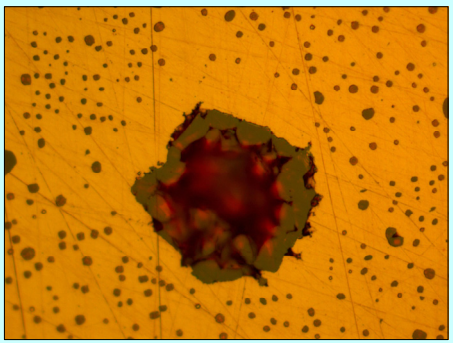

Figure 3. There is a cuprous oxide in the beaded copper. (1000X)

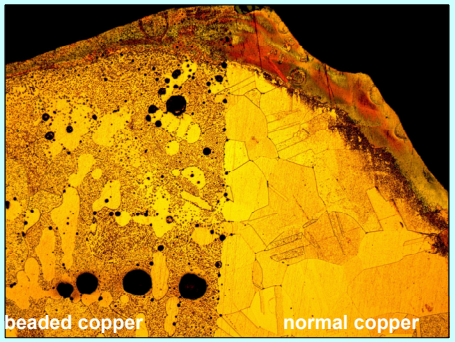

Figure 4. After etching, the grains of the copper conductor are different from the beaded copper. (100X)

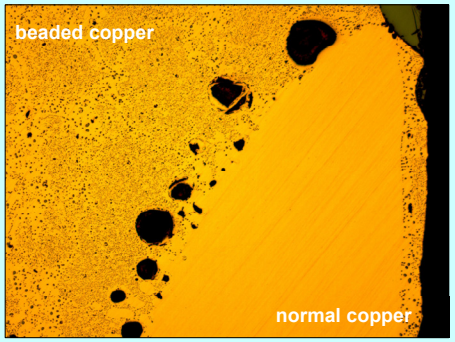

Figure 5. After polishing, there are impurities in the internal part of the bead. It is clearly different from the normal copper conductor . (100X)

Figure 6. After polishing, there are impurities in the internal part of the bead. It is clearly different from the normal copper conductor . (500X)

Introduction

Copper conductors beading caused by fire or electrical system failure. When copper conductors are exposed to fire or heat, they may re-melt. We can not determine by observation of the surface of the bead to know whether it was the caused by the fire or a result of the fire. Therefore, we need apply the metallography to observe the internal structure of the beaded copper.

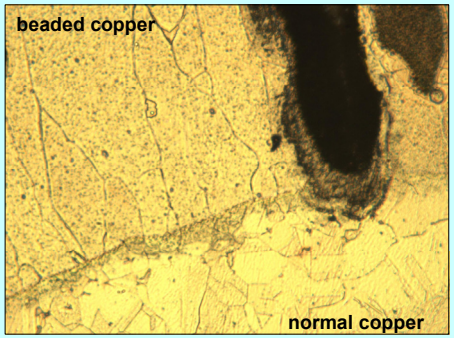

Figure 7. After etching, the grains of the copper conductor and the beaded have obvious distinct characteristics. (100X)

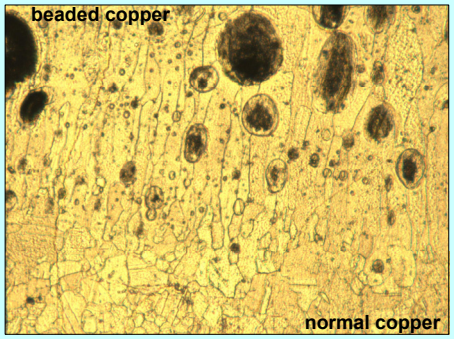

Figure 8. After etching, the beaded copper grains are columnar. (100X)

Methods

(1) Samples prepared according to the standards of ASTM E 3-01, Standard Guide for Preparation of Metallographic Specimens, 2001.

(2) Samples etched according to the standards of ASTM E 407-99, Standard Practice for Microetching Metals and Alloys, 1999.

(3) Images taken with the Microscope digital camera.

Results

(1) Gas porosity : Gas porosity have deformed and directional. There are crystalline solids in the gas porosity.

(2) Cuprous oxide : There are reddish cuprous oxide in the bead.

(3) Impurity : The bead becomes impure internally.

(4) Grain : The beaded copper grains are columnar.

Discussion

(1) Electric fault may have various degrees of porosity or not have any porosity.

(2) Crystalline solids can be found in the gas porosity of electrical system failure.

(3) Cuprous oxide can be found in the bead resulting from fire.

(4) There are impurities in the internal part of the bead.

(5) The grains of the undamaged copper conductor and the beaded copper have obvious distinct characteristics.