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Brief 66-10273

NASA TECH BRIEF

Boron–Deoxidized Copper Withstands Brazing Temperatures

The problem:

OFHC (Oxygen Free High Conductivity) plate copper used for fabrication of components that are brazed in a hydrogen atmosphere to heat transfer equipment is subject to extensive grain growth and a loss of strength at the high brazing temperatures (1550° F for an average exposure of 5 to 6 hours). The copper components installed in the heat transfer equipment are also required to withstand operating temperatures ranging from 500° to 1220° F without degradation of their mechanical properties.

The solution:

Use a commercially available boron-deoxidized, high-conductivity copper (0.005 to 0.015% boron) for fabricating the heat transfer components. The results of comparative tests show that the boron-deoxidized copper has higher strength and ductility than OFHC copper at elevated temperatures and does not exhibit massive intergranular failure.

How it's done:

OFHC copper and boron-deoxidized copper in the form of ⅝-inch-thick plate were used for machining of round tensile test specimens, which were then annealed at 925 ±20° F for 5 to 10 minutes in an argon atmosphere. One-half of each group of specimens were grain coarsened during a production braze cycle at 1910° F.

Tensile tests were run at room temperature and at 200° F, 300° F, 400° F, 500° F, and 900° F. The specimens were heated in air and held at temperature for 15 minutes prior to tensile testing at a cross-head speed of 0.005 inch/inch/minute. Grain-size and hardness measurements were made for both copper materials in the fine grained and coarse grained conditions. Representative tensile specimens were cross-sectioned for metallurgical investigation. The following is a summary of the results of the tests on the two groups of specimens:

1. OFHC copper, coarsened on exposure to the 1910° F braze cycle, exhibited tensile strengths of approximately 10,000 psi at 900° F. The yield strength remained low (5,000 psi) at all temperatures between room temperature and 900° F. The boron–deoxidized copper, exposed to the same braze cycle, exhibited slightly higher strength and ductility values than OFHC copper.
2. The braze cycle produced greater grain growth in the OFHC copper than in the boron–deoxidized copper.
3. Coarse grained OFHC copper failed intergranularly at temperatures of 400° F and higher. The coarse grained boron–deoxidized copper did not exhibit massive intergranular failure at any test temperature.
4. There was no significant difference in hardness between either copper material when tested in the annealed or brazed condition.

Note:

Inquiries concerning this innovation may be directed to:

Technology Utilization Officer
Marshall Space Flight Center
Huntsville, Alabama 35812
Reference: B66-10273

(continued overleaf)

Patent status:

Inquiries about obtaining rights for the commercial use of this invention may be made to NASA, Code GP, Washington, D.C., 20546.

Source: Erwin H. Schmidt
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under contract to
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