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Influence of Magnetic Field on Microstructure and Properties of Copper-Silver Composites

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Abstract : The Cu-alloy composites are a kind of high-strength and high-conductivity Cu-based alloys, which have excellent mechanical and electrical properties and is widely used in electronic, electrical, machinery industrial fields. However, the solidification microstructure of the composites, such as the primary or second dendrite arm spacing, have important rule to its tensile strength and conductivity, and that is affected by its fabricating method. In this paper, two kinds of directional solidification methods; the exothermic powder method (EP method) and liquid metal cooling method (LMC method), were used to fabricate the Cu-alloy composites with applied different magnetic fields to investigate their influence on the solidifying microstructure of Cu-alloy, and further the fabricated Cu-alloy composites was drawn to wires to investigate the influence of fabricating method and magnetic fields on the drawing microstructure of fiber-reinforced Cu-alloy composites and its properties. The experiment of Cu-Ag alloy under directional solidification and horizontal magnetic fields with different processing parameters show that: 1) For the Cu-Ag alloy with EP method, the dendrite is directionally developed in the cooling copper mould and the solidifying microstructure is effectively refined by applying horizontal magnetic fields. 2) For the Cu-Ag alloy with LMC method, the primary dendrite arm spacing is decreased and the content of Ag in the dendrite increases as increasing the drawing velocity of solidification. 3) The dendrite is refined and the content of Ag in the dendrite increases as increasing the magnetic flux intensity; meanwhile, the growth direction of dendrite is also affected by magnetic field. The research results of Cu-Ag alloy in situ composites by drawing deforming process show that the micro-hardness of alloy is higher by decreasing dendrite arm spacing. When the dendrite growth orientation is consistent with the axial of the samples. the conductivity of the composites increases with the second dendrite arm spacing increases. However, its conductivity reduces with the applied magnetic fields owing to disrupting the dendrite growth orientation.

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