



Electric Conductivity and Percolation Threshold Research of Cu-Cu₂O Cermet

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Abstract: Cu-Cu₂O cermet materials were prepared via hot pressing(HP) and in situ reduction hot pressing(ISRHP) technology. The results of electric conductivity tests show that the percolation threshold of the cermet material, which was prepared by HP, is lower than the one, which was prepared by ISRHP. They are 20 wt.% and 30wt.% respectively. The electric conductivity and the percolation threshold depend on four influence factors: the content, the size, the shape, and the distribution of the Cu phase. When the content of the Cu phase is higher than its percolation threshold, the electric conductivity increased 7~8 orders of magnitude, changing from insulating state into conducting state sharply. The electric conductivity decreased with increase of the Cu particle size, and decrease of the aspect ratio of the Cu particle. The more even the Cu phase distribution, the higher the electric conductivity of the cermet materials is.

Key words: Cermet; Percolation threshold; Electrical conductivity

1. Introduction

Cermet materials have great interest in many fields of materials science and engineering[1-3]. The most important merit of cermet materials is that they combine the advantages of metals and ceramics together, which means, they have good electrical or thermal conductivity as metals and good mechanical or chemical properties as ceramics.

Although there are many publications on the electrical conductivity of composites, but most of them are focused on the content of the conducting phase, however, as a matter of fact, the electrical conductivity of composites are influenced by some other factors, such as: the distribution, the size, and the shape of the raw materials as conducting phase. Percolation theory, a new life in materials science, is the one who can explain these phenomena. However, the present theory is not complete yet[2], and this paper is focus on giving some simple idea and some experimental data to percolation theory development.

The electrical conductivity of cermets are different from the pure metals, alloys, or pure ceramics. When the content of the conducting phase in cermets is higher than a critical value, the electrical conductivity increases several orders of magnitude suddenly, changing from semiconducting state into conducting state. This phenomenon can be explained as the conducting backbone has been built

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