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Enhancing the oxidation resistance of metal and alloy at high temperature by surface fluorination

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ABSTRACT

The use of silver nanoparticles in conductive inks and their printing by injecting technology has been known for years. However, the very high cost of silver limits wide industrial applications. Since copper is much cheaper, but possesses a very high conductivity (only 6% less than that of Ag), Cu nanoparticles can be considered as a replacement for silver nanoparticles. However, a major problem in utilizing their copper nanoparticles is their inherent tendency to oxidize in ambient conditions. In conductive printing applications, the presence of copper oxide on the surface of nanoparticles has two negative consequences: it increases the required sintering temperature and reduces the electrical conductivity. Only a limited number of reports have attempted to address the oxidation problem, which in general is based on minimizing the exposure of the copper nanoparticles to oxygen, by a protective layer composed of a second material at the surface of the particles. To form the protective layer on the surface, carbon-based materials, surfactants, metals, and so on. In previous study [1], we reported the effects of surface fluorination on the oxidation resistance of TiAl alloy particles. The TiAl particle surface layer changed from oxides to oxyfluorides. The TG/DTA results after heating 800℃ show that the weight increase of oxyfluorides on TiAl was distinctly less than that of untreated TiO_2 on TiAl. As same as TiAl, we tried to modify the oxide on Cu particles using fluorine gas. And the creation effects of oxyfluorides or fluorides on the oxidation resistance of Cu particles were investigated. Compared with untreated sample (a), the fluorinated samples can restrain the weight increase even at 200℃ from the TG-DTA results. It might be considered that the substantial oxyfluorides on the surface play a role in protecting metal oxidation.

REFERENCES

[1] Kimura S., Nishimura F., Kim J.H., Yonezawa S. and Takashima M. (2014), “Surface fluorination effects on TiAl particle oxidation resistance”, *Journal of Fluorine Chemistry*, **166**, 22–27.

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