A Study on Controlling Thermal Conductivity of Metal Alloy by Using Hierarchical Structure

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Abstract

The thermal conductivities of the materials are known to affect the human cognitive ability on warmness and coolness [1]. In general, human perceive coldness when skin is touched by high thermal conductive material, and perceive warmness when touched by low one [2]. The hierarchical structure can be utilized to fabricate the new materials with unique physical properties suitable for specific applications. In here, the specific hierarchical structure was studied to decrease the thermal conductivity of common metal alloys in order to perceive differently from the warm and cool sensation of common metal alloy.

In this study, changing thermal conductivity of hierarchically organized metal structure according to its porosities and geometries were calculated. The basic elements of hierarchically organized metal structure is a layer structure in which the cross-sectional shape is composed of planar and protruding parts. The porosities of this metal structure were controlled by varying the basic elements thickness and inclination angle of the protrusion. In addition, the proposed hierarchically organized metal structures were fabricated by electroforming and attachment process each basic element part. The thermal conductivities of fabricated these metal structures were measured. The thermal conductivity of Fe-Ni alloy sheet was measured as 25.05 W/m•K, while the hierarchically organized alloy structure was 0.228 W/m•K. This value is corresponding to the thermal conductivity of the polyester (0.20 W/m•K). Therefore, the thermal conductivities of metal alloys can be controlled by using hierarchical structures. Stated results can be applied to different warm and cold senses for metal products when human touches.

Keywords: *Electroforming, Hierarchical structure, Thermal conductivity, Warm and cold senses, Fe-Ni alloy*

References

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Biography

Tai Hong Yim received his Ph.D degrees in Metallurgical Engineering from Seoul National University, Republic of Korea, in 1987. He is currently a principal researcher of Surface R&D Group at Korea Institute of Industrial Technology (KITECH). His main research interests are design of alloy, fabrication of functional metals, anisotropy and texture of metals.