Thermal Conductivity of a Functionally Graded Fe-Cu-C alloy Processed by Liquid Phase Sintering and Carburization

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By the carburization of a liquid phase sintered Fe-Cu compact at temperatures above the melting point of copper or below the eutectic temperature of the Fe-Cu-C system (it is 1140□ in this research), the carbon concentration was graded, yielding a graded texture oriented to a vertical direction to the carburizing plane. The hardness is the highest at the surface and decreasing towards another end of the compact, and the thermal conductivity is improved as compared to the non-graded compact. This graded Fe-Cu-C alloy would have a technological application to a high performance valve sheet of diesel engine. In this report, the formation of the graded structure and its characterization are briefly reviewed, and the thermal conductivity of the graded compact is analyzed by Eshelby's equivalent inclusion method. We employed a microstructure model in which ellipsoidal copper particles are embedded in iron matrix. The thermal conductivity was calculated for parallel and perpendicular to carburization direction as functions of the size, aspect ratio, volume fraction of the copper particles. The predicted values were in good agreement with the experimental. The present analysis will give a good guide for the practical application of this material.