Special Feature: Metallic Materials

Overview

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Metallic materials are now used in many products, and particularly essential for automotive applications such as body-frame, wheel, engine parts, and electric devices and so on. Main task required of the metallic materials is to exhibit excellent mechanical and physical characteristics and to ensure the long-term reliability. In addition, an automotive lightening to improve fuel efficiency is an urgent matter to meet the needs of environmental protection. The reduction in vehicle's weight results from an increase in strength of the metallic materials. However, for instance, the actual strength of commercial steels have reached only 1/4–1/5 of that of the ideal/theoretical value. Therefore, the fabrication of metallic materials with higher strength has been the subject of considerable researches.

The hybrid vehicle and the electric vehicle (HV/EV) have attracted a great deal of attention because of their energy saving. Since Nd magnets are absolutely essential for the driving motor and generator of HV/EV, to reduce costs of magnets and avoid resource risks of rare earth elements, attempts have been made to improve the coercivity of Nd magnets with minimum usage of Dy. However, the coercivity of commercial magnets without Dy show around 10 kOe which corresponds to only 15% of the theoretical value, similar to the case of steel strength. Here, we believe that, in order to achieve the ideal physical properties of metallic materials, it is critical to control their microstructure.

This special issue focuses on our recent researches on three kinds of materials; (1) steels, (2) aluminum alloys, and (3) NdFeB magnets. The first three papers report microstructural transition of steels during deformation and heat treatment, including the strengthening mechanism in the developed Fe-Ni-Co-Ti alloy. The second topic is newly developed Al-Zr-Ti-Fe alloy having superior high specific strength with thermal stability, where we discuss the relationship between a microstructure and micro hardness of this new alloy. The final two papers are regarding NdFeB magnets from the viewpoint of reducing Dy usage which improve their coercivity, where we present the role of grain boundary to enhance the coercivity.