Microstructural Control of Gas Nitrided Steel and Magnetic Materials

Kaku ASADA

Professor	asada@sendai-nct.ac.jp
Affiliated Societies	The Japan Institute of Metals and Materials The Magnetics Society of Japan The Japan Society for Heat Treatment
Keywords	Phase transformation (26010), Mechanical properties (26010), Surface treatment (26030), Social infrastructure materials (26040).

Research Topics

- Mechanical and structural properties of nitriding and nitrided quenching of the steel
- Magnetic and structural properties of the 3d transition metals
- Nanostructural control of the W-Cu composite alloys prepared using high-energy milling

Research Seeds

“New material development by ammonia gas nitriding treatment”

Nitriding treatment of metals such as steel forms a nitride layer on the material surface to improve corrosion resistance and wear resistance. This method has been widely applied, but fundamental research on nitriding processes, such as the formation of nitride with alloying elements and the influence on the nitride layer growth, is lacking. This research solves these difficulties and controls the surface hardened layer through nitriding and quenching of practical steel.

In addition, because the nitrogen penetrates into the metal as an interstitial atom in the metal, it strongly influences the magnetic properties of the 3d transition metal depending on the ambient environment. This research is conducted to stabilize the metastable phase such as fcc-cobalt by nitrogen solid solution and to create a new magnetic material.

“Nano-structural control of the W-Cu composite alloys”

W-Cu composite alloys are applied to the electrode and contact materials by excellent conductivity and abrasion resistance. Peeling because of the difference in thermal expansion coefficient, which is a shortcoming of this alloy, can be alleviated by microstructure refinement and homogenization. For this study, W-Cu alloy with ultrafine structure was produced using a converge mill capable of a large amount of pulverization treatment and using a hot press technique. The recovery rate of the finely processed powder is as high as about 90 vol.%. The powder microstructure consists of crystal grains of about 100 nm. The Vickers hardness of the sintered body produced by this processed powder, even though it contains 30% copper, is superior to that of the commercial product. It shows a value of about 90% of the hardness of pure tungsten. The sintering process consists of two stages of crystal grain growth and densification. It is possible to control the benefits of wear resistance and conductivity of the sintered alloy by controlling the sintering process conditions.

Related Technology

Optical microscope, X-ray diffraction method, pulverization technique (ball milling),
Hydrogen absorption technique, magnetization measurement (VSM),
Fluorescent X-ray analysis and transmitted X-ray observation,
Gas nitriding and heat treatment technique,
Vickers and micro Vickers hardness measurement, etc.