PO4063

Simultaneous carburizing and boronizing of a pure titanium surface using spark plasma sintering

Takato Karimoto, Akio Nishimoto

Kansai University, Osaka, Japan

k226770@kansai-u.ac.jp

Titanium materials have been widely used in the aerospace, automotive, and biomaterial engineering fields owing to their superior properties. However, further applications of such materials are limited due to their low hardness, poor wear resistance, and reduced corrosion resistance to non-oxidizing acids. Therefore, Methods to coat the matrix surfaces of materials with a hard ceramic coating layer made of titanium compounds have been described to improve their mechanical properties. Moreover, titanium composites composed of carbides and borides have attracted enormous interests due to their superior properties, such as high hardness, good wear resistance, high electrical and thermal conductivities, and high fracture toughness, compared to single-phase ceramics. In this study, attention was focused on a diffusion coating method that could lead to the formation of a hard layer with excellent adhesion through the creation of an interlayer and a gradient layer. However, in conventional diffusion coating methods, the deterioration of the mechanical properties of the matrix resulting from the long-term, high-temperature processing can be problematic. Therefore, in this study, the spark plasma sintering (SPS) method was used to form a ceramic layer, since it allows the suppression of the growth of crystal grains by rapid heating and enables low temperature and short processing time. Thus, carbides and borides were simultaneously formed on a titanium surface using the SPS method. Commercially pure titanium (CP-Ti) was used as substrate, while the B_4C powder was utilized as both carburizing and boronizing source. The analysis of the sample surface subjected to the SPS processing indicated the formation of TiC, TiB_2, and TiB. Since a ceramic layer was formed on the titanium surface, a surface hardness of ~1700 HV was obtained, and the wear resistance and corrosion resistance in a 2%HF-10%HNO_3 aqueous solution were improved compared to those of untreated CP-Ti.

Keywords
spark plasma sintering
diffusion coating
carburizing
boronizing
surface modification