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論 文 要 約

Cold spray (CS) is one of thermal spray technique, and particle accelerated by supersonic gas collides and adhere to substrate by metallic bonding rather than melted by thermal energy such as traditional thermal sprays. Common particle preparation methods, such as mechanical mixing or ball milling methods, for the fabrication of metal matrix composite coating by CS have been used. However, mechanically embedded functional materials to metal particles result in structural damage during particle mixing process or aggregated. Thus, new method for particle fabrication with uniformity and less damage has been requested. In this work, two types of strategies for preparation of hybridized particles of functional material directly bonded with metal particle were proposed to solve these problems on CS. Fabrication of composite coatings by low-pressured CS using these hybridized particles was conducted, and uniformity, defect density, existence, and contents of functional materials in composite coatings were investigated in four chapters.

In chapter two, composite coating of titanium with hydroxyapatite (HAp) fabricated for uniform HAp distribution and strong adhesion between titanium and HAp was studied. Hydroxyapatite was directly fabricated on titanium particles by the particles immersion to modified simulated body fluid, and HAp-titanium composite coating was obtained from these particles by CS. The HAp in composite coating distributed uniformly with strong adhesion. In addition, osteoblasts cell adhesion induced onto the composite coating was observed due to bioactivity by HAp.

In chapter three, novel metal matrix composite coatings containing of Diamond-like carbon (DLC) film were studied. Copper or titanium particles were coated with DLC by the chemical vapor deposition (CVD), and those coated particles were deposited on Al substrate by CS to avoid structural transition of DLC. The low working gas temperature of CS brought ignorable structural transition of DLC. Moreover, effect of DLC in composite coating on tribological, anti-corrosion, and mechanical properties were investigated, and it was indicated the function of DLC was introduces to the metal matrix composite coating.

In chapter four, the fabrication of graphene-copper composite coating with less damage in graphene was described. To avoid structural damaging at mechanical milling graphene was directly deposited on copper particle by thermal CVD and the obtained hybridized particle was applied to CS to obtain composite coatings without structural damage in graphene. Whole fabrication process induced hardly damage because of absence of ball-milling and low working gas. Moreover, particles and composite coating showed no agglomerated graphene due to strong adhesion between graphene and copper. The coefficient of friction was reduced by the introduction of graphene into copper, indicating that the function of graphene could be introduced into metals as composite coating by CS from hybridized particles of graphene coated copper.

In chapter five, fabrication of carbon nanotubes (CNTs)-nickel composite coating with high CNT content by CS was described. To obtain composite coating with high CNTs content, nickel layer was formed on CNTs by electroless nickel plating because ductile nickel plays role of plastic deformation material for deposition by CS instead of brittle CNTs. As a result, this nickel layer on CNTs behaved for the acceleration of nickel coated CNTs and as plastic deformation layer at deposition.