論　文　の　要　旨

題　目　Development and characterization of carbon nanofiber/carbon nanotube/graphene reinforced aluminum matrix composite
（カーボンナノファイバー/カーボンナノチューブ/グラフェン強化アルミニウムマトリックス複合材料の開発と特性評価）

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The increasing power densities and miniaturization are the development trends of high-performance electric and electronic devices. Thus, carbon-based reinforced aluminum matrix (carbon/Al) composites for heat sink material with high thermal properties and low density are focused to meet the demand. The development of low pressure infiltration (LPI) method is attracting interest in carbon/Al composites. Therefore, a various of carbon nanofiber (CNF) reinforced Al matrix composite and carbon nanotube (CNT) reinforced Al matrix composite was developed by the LPI method. Besides, graphene reinforced Al (Graphene/Al) matrix composites were developed by the spark plasma sintering (SPS) method.

This thesis consists of 6 chapters. The main content of each chapter is briefly summarized as follows.

Chapter 1 reviews the scientific background, the manufacturing processes and the development status of metal matrix composites (MMCs) as heat sink materials. Moreover, from the problems of the previous studies of MMCs, the LPS method and SPS method for developing MMCs are proposed. The objective of this doctoral thesis is fabricating a various carbon-based reinforced MMC by LPS method and SPS method.

Chapter 2 & 3 introduces the fabrication of the porous VGCF/MP and VGCF/MP/Al composite. CNF/MP/Al composites were manufactured using a low-pressure infiltration method at 0.1 MPa. The composites with the 0.5 vol.% of CNFs showed an intimated interface between CNF/MP and Al matrix. Furthermore, the thermal conductivities of the fabricated porous CNF/MP and CNF/MP/Al composites were determined.

Chapter 4 describes the new fabrication process of CNT block reinforced Al matrix (CNT block/Al) composite. CNT block preforms were fabricated using electroless Cu-plated CNT blocks. The electroless Cu plating was utilized as surface treatment and binder of CNT blocks. The interface between the CNT blocks and the Al matrix and the reactivity of the Al matrix with the Cu layer were investigated. Furthermore, the thermal conductivities of the fabricated CNT block/Al composites were determined.

Chapter 5 introduced the Graphene/Al composites developed by SPS method. As composite properties are affected by the dispersibility and volume fraction of the graphene particles, the relationship among the dispersibility of dispersant and the thermal conductivity was investigated.

Chapter 6 summarizes the results of the above survey.