A Preliminary Process for Incorporation of Graphene Reinforcement in Copper Based Feedstock

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1.0 ABSTRACT

This study explores a processing strategy striving to overcome the challenges related to graphene incorporation in copper based feedstock for metal injection molding. Contrary to conventional graphene derivatives used to reinforce metal matrices, this study employs Cu_2O grafted graphene nanoplatelets as an alternative graphene reinforcement for copper based feedstock. It was identified that the presence of grafted copper Cu_2O nanoparticles not only favoured the distribution of graphene reinforcement but also impeded the agglomeration of graphene sheets in copper feedstock. Reinforced copper feedstock was injection molded to produce defect free green parts with graphene loading content ranging from 0.1 wt. % to 1.0 wt. %. Molded samples demonstrated good shape conformity without the presence of any macro defects, hence implying the suitability of molding parameters. Furthermore, solvent and thermal debinding processes used to leach out the binder system resulted in successful elimination of binder components without affecting the graphene reinforcement. The research work presented hereby, introduces a multi scale dispersion route for preparing homogeneously distributed graphene reinforced copper feedstock. Consequently, successful trials for injection molding and debinding processes incite the prospect of extending the scope of metal injection molding technique for development of graphene reinforced metal matrix composites.

2.0 INTRODUCTION

Following the discovery of graphene, numerous processing techniques have been employed to develop a downright fabrication route which could the extend potential of graphene reinforced bulk metallic composites [1]. Whilst, previously deployed fabrication routes have primarily manifested phenomenal strengthening capability of graphene reinforcement in metal matrices [2], yet, inhomogeneous distribution, weak interfacial interaction and agglomeration of graphene, are the primary challenges limiting the research potential of graphene reinforcement [3, 4]. That being so, the previous research efforts combat these challenges by utilizing intricate routes specifically designed to fabricate composites with simplest shape designs [5-8]. Processing method such as powder injection molding (PIM), with the inherent capability of producing near net shaped intricate parts, have not been explored for development of graphene reinforced