論文 / 著書情報
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題目(和文)	固体前駆体を導入した噴流層とグライディングアーク放電のコンビネーションを用いた粒子コーティングプロセスの開発
Title(English)	Development of Particle Coating Process Using a Combination of Gliding Arc Discharge and Spouted Bed with Solid Precursor
著者(和文)	Ua-amnueychai Warit
Author(English)	Warit Ua-amnueychai
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種別(和文)	論文要旨
Type(English)	Summary

（博士課程）
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論 文 要 旨

THESIS SUMMARY

専攻： Department of	Chemical Engineering 専攻	申請学位（専攻分野）： Academic Degree Requested	博士 Doctor of (Engineering)
学生氏名： Student's Name	Warit Ua-amnueychai	指導教員（主）： Academic Advisor(main)	Hidetoshi Sekiguchi
		指導教員（副）： Academic Advisor(sub)	

要旨（英文 800 語程度）
Thesis Summary（approx.800 English Words ）

In this research work, we aim to develop and investigate a novel particle coating process using a combination of gliding arc discharge and spouted bed condition with solid precursor. The coating morphology, behaviors, and mechanisms were investigated using a zinc solid precursor and PMMA particle model system. This work considered the effect of several process parameters related to the gliding arc discharge and spouted bed on coating behaviors, including coating amount, surface coverage, coating thickness, and bulk electrical conductivity. The process parameters that were studied in this work are coating duration, applied voltage, PMMA particle size, zinc/PMMA mass ratio in the bed, electrode angle, and type of plasma gas. The spouting condition and gliding arc discharge were also investigated. In addition, the feasibility of the novel coating process on different types of solid precursor and coating target were studied.

Chapter 1 Introduction, describes and explains coating process, plasma technology, and hybrid system between plasma and spouted bed. The research objectives and approaches were also presented in this chapter.

Chapter 2 Experimental and General Coating Behavior, describes the experimental procedure. In addition, the coating morphology and coating behaviors, consisting of coating amount, percentage coverage, thickness, and bulk electrical conductivity as a function of coating duration were discussed. The feasibility of this novel particle coating process using zinc solid precursor and PMMA particle as a coating target was also confirmed. Two different coating structures were observed on the PMMA surface, a smooth coating structure and a thick rough coating structure. The coating process was successful due to the conductive nature of the solid precursor and the non-conductive of the substrate. The conductive nature of the solid precursor allowed them to gain energy from the gliding arc discharge, while the non-conductive nature of the substrate prevented the substrate from melted by the gelding arc discharge. The amount of zinc coating increased with coating time but reached an equilibrium after 20 min. As coating duration increased, the coating thickness also increased, while the percentage surface coverage remained relatively constant after 10 min of the coating time. From the coating process, electrical conductivity was imparted to the non-conductive PMMA particles.

Chapter 3 Effect of Process Parameters Related to Gliding Arc Discharge and Spouted Bed, studies the effect of applied voltage, PMMA particle size, zinc/PMMA mass ratio in the bed, electrode angle, and type of plasma gas on coating behaviors for a model system of zinc solid precursor and PMMA particle. The applied

voltage affected the energy provided to the system. The transition from low applied voltage to high applied voltage regime resulted in a decrease in the amount of zinc coating and thickness of the coating layer. This is due to the decrease in the physical contact coating mechanism. As the size of the PMMA particle increased, the frequency of collision between zinc solid precursor and PMMA particle also decreased. This resulted in a decrease in the amount of zinc deposition per surface area at low applied voltage, while no significant change was observed at high applied voltage. The zinc/PMMA mass ratio in the bed and the rate of coating are in a direct relationship. On the other hand, the electrode angle had a significant impact on the gliding arc discharge reactive area. The decrease in the gliding arc discharge reactive area resulted in the negative impact of the coating amount at prolonged period of coating time. Moreover, the use of nitrogen gas can alter both the energy supply and the stability of the gliding arc discharge. However, small increase in the nitrogen plasma gas concentration did not have an observable impact on the coating behaviors, while large increase in the nitrogen gas concentration resulted in the melting of PMMA particle due to excessive energy supply.

Chapter 4 Variation in Particle Types, studies the feasibility of this particle coating process with different solid precursor and substrate. Two systems were chosen for this study; 1) copper solid precursor and PMMA particle system and 2) zinc solid precursor and silicon dioxide system. In the case of copper solid precursor and PMMA particle system, due to high melting and boiling point of the copper solid precursor, the coating process was not successful. This shows that a solid precursor with relatively low melting and boiling point is required for this novel particle coating process. On the other hand, zinc coating structure was observed for the zinc solid precursor and silicon dioxide coating target system. Even though, the electrical conductivity was highly fluctuated in value due to the non-spherical shape of the silicon dioxide, the successful coating performance shows that ceramic substrate can be used with this novel particle coating process.

Chapter 5 Coating Mechanisms, describes the coating mechanisms of the novel particle coating process based on zinc solid precursor and PMMA particle system. Both zinc vapor deposition coating mechanism and physical contact with the partially melted zinc solid precursor coating mechanism were discussed. The zinc vapor deposition coating mechanism gave a fine coating structure, while the physical contact with partially melted zinc solid precursor coating mechanism gave a thick rough coating structure. The coating mechanisms can be controlled, to a certain extent, by adjusting the applied voltage used to generate the gliding arc discharge and the size of the PMMA particle.

Chapter 6 Conclusion, summarizes the findings obtained from this study and provide recommendations for future prospects. The proposed novel particle coating process using a combination of gliding arc discharge and spouted bed with solid precursor shows a promising future for the particle coating application.