論　文　の　要　旨

題　目　One-step Gas Phase Fabrication of Semiconductor-based Nanomaterials and Their Characteristics with Enhanced Photocatalytic Performance
（半導体系ナノ材料のワンステップ気相作製と増大した光触媒性能を含む特性）

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In this dissertation, semiconductor-based photocatalysts were fabricated via gas-phase methods, specifically utilizing a one-step plasma-enhanced chemical vapor deposition and physical vapor deposition (PECVD-PVD) process and spray pyrolysis (SP). These methods were employed to fabricate photocatalysts using semiconductor materials such as TiO_2 and ZnO. Incorporation of CuO or Ag was undertaken to enhance their characteristics and activity. This dissertation is structured into five chapters, each delving into specific aspects of the fabrication method, characterization, and applications of these photocatalytic materials.

Chapter 1 elaborates on the detailed exploration of the materials utilized and the various processes involved in nanomaterial fabrication and their applications in advanced oxidation processes (AOPs), specifically photocatalysis. This overview serves as the motivation behind the research investigation within the scope of this dissertation.

Chapter 2 explores the production of TiO_2-CuO nanoparticulate thin films via a one-step PECVD-PVD method, followed by an assessment of their photocatalytic activity under visible light, considering the anatase or rutile crystalline phases, which is altered by the increase of the post-deposition annealing temperature. Results showed, the rutile- TiO_2-CuO film exhibited superior photocatalytic activity compared to anatase- TiO_2-CuO. Further investigation focused on the characteristics of anatase TiO_2-CuO. Additionally, the photocatalytic activity was explored by alterations in UV or visible light exposure, pH, and the addition of H_2O_2 to the photodegradation system. The results showed that TiO_2-CuO/H_2O_2 at pH 13 exhibited the highest photocatalytic activity.

Chapter 3 extends the investigation of TiO_2-based photocatalysts by loading noble-metal Ag nanoparticles. Utilizing the same fabrication system as in **Chapter 2**, Ag-loaded TiO_2 was fabricated. The addition of Ag extends the light absorbance of to TiO_2 the visible light wavelengths. Results demonstrated that at specific Ag concentrations, TiO_2-Ag exhibits superior photocatalytic activity compared to pristine TiO_2 under visible light irradiation. Additionally, this chapter delves into a comprehensive examination of how variations in the heating rate during post-deposition annealing affect the characteristics of TiO_2-Ag such as crystallinity and BET.

Chapter 4 expands the scope of semiconductor-based photocatalysts beyond the one-step PECVD-PVD method and TiO_2-based materials. It explores alternative fabrication methods and materials by focusing on the synthesis of Ag-loaded ZnO using SP. The process resulted in crumpled-shaped nanoparticles. The photocatalytic activity was assessed for treating real textile wastewater, offering insights into its potential application in environmental remediation. The photocatalytic activity of ZnO-Ag was higher compared to ZnO.

Chapter 5 Summarizes the key findings from all chapters and suggests future research directions.