別紙４－１（課程博士（英文））

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Abstract (Doctor)

Title of Thesis	Engineered Design of Efficient Nanostructured Photocatalysts for Energy Storage and Conversion Applications

Approx. 800 words

The need for sustainable energy conversion and storage technologies has become increasingly vital in addressing the global energy crisis and environmental challenges. In this context, the development of efficient and versatile photocatalysts holds great promise. This doctoral thesis focuses on the design, synthesis, and characterization of novel nanostructured photocatalysts for energy storage and conversion applications, specifically water treatment (dye degradation - microbial disinfection) , photocatalytic water splitting and hydrogen (H_2) production and energy storage applications such as supercapacitors.

The first part of the research investigates the application of nanostructured photocatalysts in water treatment processes, with a particular emphasis on dye degradation and inactivation of waterborne pathogens. Traditional water treatment methods often fall short in eliminating organic, inorganic dyes and heavy metals, which pose a significant threat to water resources. Through the utilization of nanostructured photocatalysts, enhanced photocatalytic degradation of dyes can be achieved. In addition, microbial elimination of the pathogenic microorganisms causing serious health issues to humans and the aquatic environment can become accessible. This study explores the optimization of catalyst composition, morphology, and surface properties to enhance dye degradation efficiency, thereby providing a viable solution for water purification.

The second part of the research focuses on the utilization of nanostructured photocatalysts for photocatalytic water splitting and (H_2) production. The photocatalytic conversion of water into hydrogen fuel offers a promising route for clean and sustainable energy production. The thesis investigates the synthesis and characterization of novel nanostructured materials with enhanced light absorption properties, efficient charge separation, and improved catalytic activity for water splitting. The aim is to develop highly efficient and stable photocatalysts capable of harnessing solar energy to generate hydrogen as a clean energy source.

Lastly, this thesis explores the application of nanostructured photocatalysts in energy storage devices, particularly supercapacitors. Supercapacitors have garnered considerable attention as energy storage systems due to their high-power density, rapid charge-discharge rates, and long cycle life. The research investigates the design and fabrication of nanostructured electrode materials with enhanced surface area and electrical conductivity, aiming to improve the energy storage capacity and cycling stability of supercapacitors. The incorporation of nanostructured photocatalysts into supercapacitors offers the possibility of simultaneously harvesting solar energy and storing it as electrical energy.

Overall, this doctoral thesis contributes to the field of energy conversion and storage by presenting the development of novel nanostructured photocatalysts for addressing global environmental and energy challenges. The research findings provide insights into the design principles of efficient and stable photocatalysts, leading to the advancement of sustainable energy technologies. The outcomes of this study hold the potential to revolutionize the fields of water treatment, photocatalysis, and supercapacitors, ultimately contributing to the realization of a cleaner and more sustainable future.