

**EFFECT OF POLYELECTROLYTES ON THE SYNTHESIS OF CERIUM  
OXIDE FOR PHOTO-CATALYTIC APPLICATION**

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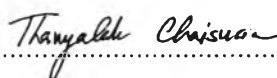


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## ABSTRACT

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Photo-catalysis is a method to treat wastewater drained from apparel industries. Cerium oxide ( $\text{CeO}_2$ ) or Ceria is a photo-catalyst which could be used to treat dyes in wastewaters. Ag nanoparticles were synthesized by chemical reduction using Poly(styrene sulfonate-co-maleic acid) (COPSS) and Sodium borohydride ( $\text{NaBH}_4$ ) as a capping agent and a reducing agent, respectively. Furthermore,  $\text{CeO}_2$  nanoparticles were synthesized at the surface of Ag nanoparticles by precipitation technique using Cerium(III)nitrate hexahydrate ( $\text{Ce}(\text{NO}_3)_3 \cdot 6\text{H}_2\text{O}$ ), and Sodium carbonate ( $\text{Na}_2\text{CO}_3$ ) as precursors and undergoes calcination at  $550^\circ\text{C}$  in order to increase the photo-catalytic activity. In this study, many factors were varied i.e. effect of  $\text{CeO}_2$  on Ag nanoparticle for photo-catalytic activity, effect of dosage of Silver nitrate ( $\text{AgNO}_3$ ) and COPSS on photo-catalytic activity, and effect of concentrations and types of polyelectrolyte on synthesis of  $\text{CeO}_2$ . This work consists of two parts which are the synthesis of  $\text{CeO}_2$  using polyelectrolytes and the synthesis of  $\text{CeO}_2$  at the surface of Ag nanoparticles. Firstly, polyelectrolytes can control the size of  $\text{CeO}_2$  and showed better photo-catalytic activity than pure  $\text{CeO}_2$  due to the smaller particles size. The best to least polyelectrolytes used in this work is Poly(acrylic acid) (PAA), COPSS, Poly(styrene sulfonate) (PSS) and Poly(diallyl dimethyl ammonium chloride) (PDADMAC). Secondly,  $\text{CeO}_2$  with Ag nanoparticles were successfully synthesized and the particles are smaller and finer than pure  $\text{CeO}_2$ . Additionally, it also improves the photo-catalytic activity of  $\text{CeO}_2$  under UV irradiation because Ag nanoparticles can prevent the recombination reaction and enhanced photon harvest.

## บทคัดย่อ

เจษฎา ชวลิตกุล : การสังเคราะห์ซีเรียมออกไซด์โดยใช้พอลิเมอร์ หรืออนุภาคซิลเวอร์ขนาดนาโนเพื่อใช้ในการบำบัดน้ำเสีย (Effect of Polyelectrolytes on Synthesis of CeO<sub>2</sub> for Photo-catalytic Application) อ. ที่ปรึกษา : ผู้ช่วยศาสตราจารย์ ดร. สเตฟาน เชียร์รี่ คูบาส 77 หน้า

โฟโตคะตะไลซิส คือ กระบวนการในการบำบัดน้ำเสียจากโรงงานอุตสาหกรรมเสียให้สามารถนำกลับมาใช้ใหม่ได้อีกครั้ง โดยใช้แสงเป็นตัวช่วยกระตุ้น และสารที่ใช้ในการบำบัดน้ำเสียนั้นจะเรียกว่า โฟโตคะตะลิส ชนิดของโฟโตคะตะลิสมีหลายชนิด แต่ในงานชิ้นนี้จะเลือกใช้ซีเรียมออกไซด์เป็นคะตะลิสในการบำบัดน้ำเสีย ในงานวิจัยนี้จะหาวิธีในการสังเคราะห์ซีเรียมออกไซด์ และวิธีในการเพิ่มประสิทธิภาพของซีเรียมออกไซด์ในการบำบัดน้ำเสีย โดยจะทำการสังเคราะห์ซีเรียมออกไซด์ 2 วิธี ได้แก่ สังเคราะห์ซีเรียมออกไซด์โดยใช้พอลิเมอร์ช่วยในการสังเคราะห์ และสังเคราะห์ซีเรียมออกไซด์บนพื้นผิวของอนุภาคเงินระดับนาโน ในส่วนของการใช้พอลิเมอร์ช่วยในการสังเคราะห์ซีเรียมออกไซด์นั้นพบว่า พอลิเมอร์สามารถควบคุมขนาดของอนุภาคซีเรียมออกไซด์ และเพิ่มประสิทธิภาพในการบำบัดน้ำเสียได้ โดยประสิทธิภาพของพอลิเมอร์ที่ใช้ในการเพิ่มประสิทธิภาพการบำบัดน้ำเสีย เรียงลำดับจากมากไปน้อยดังนี้ พอลิอะคลิลิกแอซิด พอลิสไตรีนซัลโฟเนต โคมะเลอิกแอซิด พอลิสไตรีนซัลโฟเนต และพอลิไคเอริลไดเมทิลแอมโมเนียมคลอไรด์ตามลำดับ สำหรับการสังเคราะห์ซีเรียมออกไซด์บนอนุภาคซิลเวอร์ขนาดนาโนนั้นพบว่า อนุภาคของซีเรียมออกไซด์ที่ได้มีขนาดเล็กกว่าสังเคราะห์ซีเรียมออกไซด์แบบปกติ และยังสามารถเพิ่มประสิทธิภาพในการบำบัดน้ำเสียได้ภายใต้แสงยูวี

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