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**SOLVOTHERMAL SYNTHESIS OF SPINEL-TYPE ZINC GALLATE AND  
ZINC ALUMINATE POWDERS**

**Miss Paveena Sangthonganothai**

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ปฏิกิริยาทางความร้อนของซิงค์อะซิเตตและแกลเลียมอะซิเตลอะซิโตเนตตามปริมาณสารสัมพันธ์(อัตราส่วนโดยอะตอมของสังกะสีต่อแกลเลียมเท่ากับ0.50) ในตัวทำละลายอินทรีย์ประเภทไกลคอล (1,4-บิวเทนไดออล) และสารละลายอินทรีย์ประเภทแอลกอฮอล์ (1-บิวทานอล และ 2-โพรพานอล) ที่อุณหภูมิการทำปฏิกิริยา 300°C ภายใต้สภาวะการเพิ่มขึ้นของความดันตามอุณหภูมิ จะให้ผลิตภัณฑ์เป็น ซิงค์แกลเลตที่มีโครงสร้างผลึกเป็นแบบสไปเนล ที่มีขนาดเส้นผ่านศูนย์กลาง 8 ถึง 19 นาโนเมตร และพื้นที่ผิว 52 ถึง 113 ตารางเมตรต่อกรัม ส่วนในตัวทำละลายอินทรีย์ที่เอื้อต่อปฏิกิริยา (โทลูอิน) ไม่เกิดปฏิกิริยาให้ซิงค์แกลเลต แต่ปฏิกิริยาทางความร้อนของซิงค์อะซิเตตและอะลูมิเนียมไฮดรอกไซด์ สามารถเกิดขึ้นได้ในตัวทำละลายอินทรีย์ทุกชนิดดังกล่าว ให้ผลิตภัณฑ์เป็นซิงค์อะลูมินิตที่มีโครงสร้างผลึกแบบสไปเนล มีขนาดเส้นผ่านศูนย์กลาง 7 ถึง 11 นาโนเมตร และพื้นที่ผิว 80 ถึง 198 ตารางเมตรต่อกรัม สมบัติทางกายภาพและความเสถียรทางความร้อนของซิงค์แกลเลตและซิงค์อะลูมินิตที่ทำการสังเคราะห์ขึ้นสามารถที่จะควบคุมได้โดยปฏิกิริยาของการเกิดผลึกซึ่งขึ้นกับชนิดของตัวทำละลาย นอกเหนือจากสภาวะการเกิดปฏิกิริยา และโครงสร้างของกลุ่มอัลคิลของโลหะอัลคอกไซด์ ปฏิกิริยาของการเกิดผลึกที่เกิดขึ้นได้อย่างรวดเร็วจะทำให้การตกผลึกของผลิตภัณฑ์เกิดเป็นซิงค์แกลเลตและซิงค์อะลูมินิตที่มีโครงสร้างผลึกแบบ สไปเนลที่สมบูรณ์และมีความเสถียรทางอุณหภูมิสูง ในงานวิจัยนี้ พบว่า ขนาดผลึกของซิงค์แกลเลตและซิงค์อะลูมินิตเปลี่ยนแปลงไปตามชนิดของตัวทำละลายอินทรีย์ที่ใช้ แต่ความเสถียรทางความร้อนของซิงค์แกลเลตและซิงค์อะลูมินิตไม่ขึ้นกับชนิดของตัวทำละลายอินทรีย์ที่ใช้ แต่ขึ้นโดยตรงกับขนาดผลึก นอกจากนี้ยังพบว่า ซิงค์อะลูมินิตมีความเสถียรทางความร้อนสูงกว่าซิงค์แกลเลตในช่วงอุณหภูมิในการคัลไซน์ที่ไม่สูง แต่เมื่ออุณหภูมิในการคัลไซน์สูงขึ้น ซิงค์แกลเลตกลับมีความเสถียรทางความร้อนที่ดีกว่า อย่างไรก็ตาม การลดลงของความเสถียรทางความร้อนของซิงค์อะลูมินิตจะมากกว่า ซิงค์แกลเลตเมื่อมีการเปลี่ยนแปลงขนาดผลึกเพียงเล็กน้อย แต่การมีโลหะตัวที่สองอยู่ในโครงสร้างจะช่วยเพิ่มความเสถียรทางความร้อนให้กับโลหะออกไซด์ได้

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KEY WORD:SPINEL, ZINC ALUMINATE, ZINC GALLATE

PAVEENA SANGTHONGANOTHAI: SOLVOTHERMAL SYNTHESIS  
OF SPINEL-TYPE ZINC GALLATE AND ZINC ALUMINATE POWDERS

THESIS ADVISOR: DR.SUPHOT PHATANASRI,

THESIS CO-ADVISOR: PROF. PIYASAN PRASERTHDAM,

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Thermal reaction of zinc acetate and gallium acetylacetonate, stoichiometric ratio  $Zn/Ga = 0.50$ , in 1,4-butanediol (glycol organic media), 1-butanol and 2-propanol (alcohol organic media) at 300 °C under autogeneous pressure yielded nanocrystalline spinel zinc gallate with diameter between 8 and 19 nm and BET surface area between 52 and 113  $m^2 g^{-1}$ . However, the reaction of them did not take place and not yielded zinc gallate in toluene. As thermal reaction of zinc acetate and aluminium isopropoxide took place in all type of organic media (1,4-butanediol, 1-butanol, 2-propanol and toluene). That yielded the nanocrystalline zinc aluminate with diameter between 7 and 11 nm and BET surface area between 80 and 198  $m^2 g^{-1}$ . When the reaction of crystallite formation occurs rapidly and so does the crystallization of the products then obtain as-synthesized well-crystallized spinel zinc gallate and zinc aluminate having high thermal stability. In this work, found that crystallite sizes of zinc gallate and zinc aluminate depend on type of the organic solvent. As for thermal stability of zinc gallate and zinc aluminate not depend on type of organic solvent but on the crystallite size. Thermal stability of zinc aluminate is better than zinc gallate in early calcination temperature. Conversely, at higher calcination temperature, zinc gallate is more stable than zinc aluminate. And the thermal stability decreasing of zinc aluminate is higher than zinc gallate when crystallite size is decreased. However, the presence of the second metal in the structure could be increased the thermal stability of the single metal oxide.

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