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จุฬาลงกรณ์มหาวิทยาลัย

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CALCIUM PHOSPHATE THIN FILM FORMATION ON TITANIUM SUBSTRATE  
BY ELECTROCHEMICAL METHOD



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ศูนย์วิทยทรัพยากร  
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อาจริยา รั้งงาม: การเกิดฟิล์มบางของแคลเซียมฟอสเฟตบนไททาเนียมซับสเตรตโดยวิธีเคมีไฟฟ้า (CALCIUM PHOSPHATE THIN FILM FORMATION ON TITANIUM SUBSTRATE BY ELECTROCHEMICAL METHOD) อ.ที่ปรึกษา: อ.ดร.ดุจฤทัย พงษ์เก่า, 104 หน้า, ISBN: 974-17-5943-6

การเตรียมฟิล์มบางแคลเซียมฟอสเฟตบนไททาเนียมซับสเตรตโดยวิธีเคมีไฟฟ้า แบ่งเป็น 4 ส่วนตามชนิดของอิเล็กโทรไลต์ ดังนี้ สารละลาย MCPM ในน้ำ สารละลาย MCPM ในน้ำที่มีการเติมอิออน สารละลาย MCPM ในเอทานอล 20% และ 50% โดยปริมาตร และสารละลาย DCPD ในกรดฟอสฟอริกเข้มข้น 1 โมลาร์ โลหะไททาเนียมบริสุทธิ์ (99.99%) ขนาด 0.8 x 2 ซม. ซึ่งผ่านการทำความสะอาดและกัดด้วยกรดไฮโดรฟลูออริกเข้มข้น 2 โมลาร์ เป็นเวลา 1 นาที ก่อนที่จะทำการเตรียมฟิล์มโดยวิธีทางเคมีไฟฟ้าทุกครั้งถูกใช้เป็นซับสเตรตในการศึกษา

จากการศึกษาพบว่าฟิล์มบางแคลเซียมฟอสเฟตสามารถเกิดได้ เมื่อผ่านความหนาแน่นกระแสพิสัยลบในภาวะที่ต่างกันดังนี้  $-10 \text{ mA/cm}^2$  สำหรับสารละลาย MCPM ในน้ำ  $-20 \text{ mA/cm}^2$  สำหรับสารละลาย MCPM ในน้ำที่มีการเติมอิออน  $-10 \text{ mA/cm}^2$  สำหรับสารละลาย MCPM ในเอทานอล 20% และ  $-20 \text{ mA/cm}^2$  สำหรับสารละลาย MCPM ในเอทานอล 50% โดยปริมาตร ส่วนสารละลาย DCPD ในกรดฟอสฟอริกเข้มข้น 1 โมลาร์ จะใช้ความหนาแน่นกระแสสูงถึง  $-300 \text{ mA/cm}^2$  ความหนาของฟิล์มที่ได้แปรผันโดยตรงกับชนิดของอิเล็กโทรไลต์และเวลาที่ใช้ในการผ่านกระแสไป เฟสหลักของฟิล์มที่ได้จากสารละลาย MCPM ในน้ำคือ บรูไซต์ ซึ่งเกิดปนกับโมเนไทต์ ในขณะที่สารละลาย MCPM ในน้ำที่มีการเติมอิออน  $\text{NO}_3^-$  กับ  $\text{F}^-$  จะมีอะพาไทต์เกิดร่วมด้วย ในทางตรงกันข้ามฟิล์มที่ได้จากสารละลาย MCPM ในเอทานอล จะมีโมเนไทต์เกิดเป็นเฟสหลัก การยึดติดของฟิล์มบนผิวของไททาเนียมซับสเตรต เมื่อทดสอบด้วย Balance beam scrape adhesion tester พบว่าฟิล์มที่ได้จากสารละลาย MCPM ในน้ำสามารถรับแรงได้สูงสุดที่ 150 กรัม และเมื่อนำตัวอย่างฟิล์มที่ได้ไปแช่ในสารละลายจำลองสารละลายร่างกายพบว่าเกิดอะพาไทต์แบบเดียวกับที่พบในกระดูก

ภาควิชาวัสดุศาสตร์

สาขาวิชาเทคโนโลยีเซรามิก

ปีการศึกษา 2547

ลายมือชื่อนิสิต..... อาริษา รั้งงาม

ลายมือชื่ออาจารย์ที่ปรึกษา..... อ.ดร.ดุจฤทัย พงษ์เก่า

ลายมือชื่ออาจารย์ที่ปรึกษาร่วม..... -

## 4572590323 : MAJOR CERAMIC TECHNOLOGY

KEYWORD : ELECTROCHEMICAL DEPOSITION/ HYDROXYAPATITE/ TITANIUM/ CALCIUM PHOSPHATES/ THIN FILM

ACHARIYA RAKNGARM: CALCIUM PHOSPHATE THIN FILM PREPARATION ON TITANIUM SUBSTRATE BY ELECTROCHEMICAL METHOD, THESIS ADVISOR: DUJREUTAI PONGKAO, D.Eng, 104 pp., ISBN: 974-17-5943-6

Electrochemical deposition of calcium phosphate thin film on titanium substrate in four different kinds of electrolyte, MCPM based aqueous solution, MCPM based aqueous solution with ions addition, MCPM based 20% V/V and 50% V/V ethanol solutions, and DCPD based 1 M-H<sub>3</sub>PO<sub>4</sub> solution was carried out by the cathodic reactions. The pure titanium metal (99.99%) with 0.8 x 2-cm sized was used as a substrate for electrolytic deposition. The substrate was etched in 2 M-HF for 1 minute before electrolytic deposition process.

The calcium phosphates thin film could be formed in a negative regions at -10 mA/cm<sup>3</sup> for MCPM based aqueous solution, -20 mA/cm<sup>2</sup> for MCPM based aqueous solution with ions addition, -10 mA/cm<sup>2</sup> and -20 mA/cm<sup>2</sup> for MCPM based 20% V/V ethanol and 50% V/V ethanol solutions, respectively. In addition, the optimum current density for DCPD based 1 M-H<sub>3</sub>PO<sub>4</sub> solution was -300 mA/cm<sup>2</sup>. The film thickness was varied depending on each kind of electrolytes and deposition time. The major phase appeared in the film from MCPM based aqueous solution was brushite co-existed with monetite and apatite was able to form with the addition of NO<sub>3</sub><sup>-</sup> and F<sup>-</sup>. On the other hand, monetite was formed as a major phase under the electrolyte condition of MCPM-based ethanol solution. The highest adhesion value of film to substrate formed by MCPM electrolyte based aqueous solution investigated by balance beam scrape adhesion tester was 150g. After soaking in revised-simulated body fluid (R-SBF) for interval times, the amorphous bone-like apatite occurred.

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Field of study Ceramic Technology

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