

**ADHESION AND PERMEABILITY OF POLYIMIDE-CLAY  
NANOCOMPOSITE AS PROTECTIVE COATING  
FOR MICROELECTRONIC GAS SENSOR**

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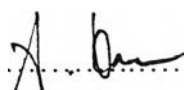
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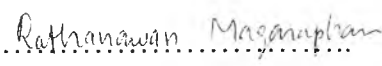
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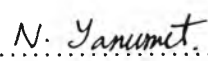
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## บทคัดย่อ

อรสา ขยันการ : คุณสมบัติการยึดติดและการแพร่ผ่านของวัสดุฉนวนผสมระหว่างพอลิอิมิด-ดินสำหรับเคลือบปกป้องตัวตรวจวัดก๊าซแบบอิเล็กทรอนิกส์ (Adhesion and Permeability of Polyimide-Clay Nanocomposite as Protective Coating for Microelectronic Gas Sensor) อ. ที่ปรึกษา : ศ. โจฮันเนส ดับบลิว ชวานค์ (Prof. Johannes W. Schwank) และ ดร. รัตนวรรณ มกรพันธุ์ 61 หน้า ISBN 974-334-185-4

สารฉนวนผสมระหว่างพอลิอิมิดและดินสามารถเตรียมจากสารละลายกรดพอลิเอมิกชนิด BPDA-PDA และดินที่ผ่านการปรับสภาพโดยใช้โคเดคซิลเอมีนแล้ว การตรวจสอบการเข้าไปอยู่ของสารปรับสภาพในโครงสร้างของดินทำโดยเทคนิค FTIR, TGA, WAXD และ AAS จากนั้นเตรียมฟิล์มพอลิอิมิดและฟิล์มของสารฉนวนผสมระหว่างพอลิอิมิดและดินและนำฟิล์มที่ได้ทั้งหมดไปตรวจสอบคุณสมบัติการแพร่ผ่านของก๊าซ ค่าความต้านทานไฟฟ้า และการยึดติดของแผ่นฟิล์มกับผิวของแผ่นซิลิคอน ผลการศึกษาการแพร่ผ่านของก๊าซพบว่า ปริมาณของดินที่เติมลงในวัสดุฉนวนเพียงแค่อ้อยละ 3 โดยน้ำหนัก ทำให้ค่าการแพร่ผ่านของก๊าซออกซิเจนลดลงมากกว่าครึ่งหนึ่งของค่าการแพร่ผ่านของก๊าซออกซิเจนที่ได้จากฟิล์มพอลิอิมิด นอกจากนี้วัสดุฉนวนนี้ยังมีค่าความต้านทานไฟฟ้าเพิ่มขึ้น ทั้งนี้เนื่องจากการขัดขวางการเกิดร่างแหการนำไฟฟ้าโดยชั้นซิลิเกตในดิน และที่สำคัญคือค่าการยึดติดของแผ่นฟิล์มกับผิวของแผ่นซิลิคอนเพิ่มขึ้นเมื่อปริมาณของดินที่เติมลงในวัสดุฉนวนเพิ่มมากขึ้น

**ABSTRACT**

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Polyimide-clay (PI-clay) nanocomposite was prepared from solution of poly(amic acid), precursor of 2,2-bis[4-(3,4-dicarboxyphenoxy)phenyl]propane dianhydride and *p*-phenylenediamine, and dodecylamine-montmorillonite. Fourier transform infrared spectroscopy, thermogravimetric analysis, X-ray diffraction, and atomic absorption spectroscopy were used to verify the incorporation of modifying agents into the structure of clay and intercalation of modified clay into the polyimide matrix. Both PI and PI-clay films were subsequently prepared by means of solution casting techniques. Gas permeability, resistivity, and adhesion properties were determined. In the case of gas permeability, only 3 wt% addition of clay brought permeability of O<sub>2</sub> gas to values less than half of that of unfilled polyimide. Furthermore, this hybrid showed an improvement in electrical resistivity due to the prevention of electrical tree growth by clay particles. More importantly, adhesion between the films and silicon was increased with increasing clay content.

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