

**PIEZOELECTRIC POLYMER FOR MECHANICAL SENSORS
IN SMART CARD APPLICATIONS**



Teerapol Sodsong

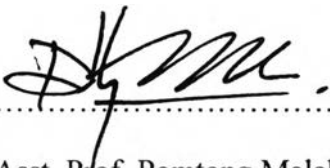
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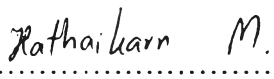
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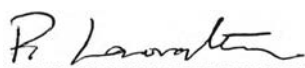
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ABSTRACT

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Keywords: Polyvinylidene fluoride/Laminated or Multilayered film/Dielectric properties/Piezoelectric properties

In this research, lamination technique was used to improve piezoelectric properties of PVDF. Laminated or multilayer system shows unusually high piezoelectricity because of charge interfering at the interface—charge has been accumulated at the interface of each layer. PVDF film and PVDF/Ba_{0.7}Sr_{0.3}TiO₃ composite film were used to prepare laminate films in different series by compression molding. Solution-casting technique was used to fabricate thin film of PVDF and composite. Ba_{0.7}Sr_{0.3}TiO₃ was synthesized via sol-gel method. And compression technique was used to laminate PVDF with PVDF/Ba_{0.7}Sr_{0.3}TiO₃ layers. Dielectric properties of Ba_{0.7}Sr_{0.3}TiO₃ ceramic, composite film and laminate film was measured at the frequency range of 1 kHz to 1 MHz by Impedance/Gain-Phase Analyzer. FTIR result showed that mechanical stretching affected to β -crystalline phase of PVDF film as the decreasing of β -phase content. The highest dielectric constant was observed in original casted PVDF film however as stretching ratio was increased, the dielectric loss was improved resulting from the less porosity. By adding Ba_{0.7}Sr_{0.3}TiO₃ ceramic into the film, the composite film at higher Ba_{0.7}Sr_{0.3}TiO₃ ceramic content yielded higher dielectric constant at all frequencies. The dielectric properties of laminated films from PVDF film and PVDF/ Ba_{0.7}Sr_{0.3}TiO₃ composite film were improved by less dissipation factor and the effective dielectric constant of the multilayer structure was related to a series connection model of PVDF and PVDF/BST composite layer dielectrics. The hysteresis loop of laminated film was observed showing the ferroelectric behavior.

บทคัดย่อ

ธีรพล โสคสงค์ : เพียโซอิเล็กทริกพอลิเมอร์สำหรับอุปกรณ์ตรวจจับแรงสั่นสะเทือนในการประยุกต์ใช้กับสมาร์ทการ์ด (Piezoelectric Polymer for Mechanical Sensors in Smart Card Applications) อ. ที่ปรึกษา ผู้ช่วยศาสตราจารย์ ดร. หทัยกานต์ มนต์ปิยะ 76 หน้า

งานวิจัยนี้ได้้นำเอาวิธีการทำลามิเนชัน (lamination) มาทำการเพิ่มคุณสมบัติทางเพียโซอิเล็กทริก (piezoelectric properties) ของพอลิไวนิลลิดีน ฟลูออไรด์โพลิเมอร์ (polyvinylidene fluoride) เนื่องจากความพิเศษทางด้านการสะสมประจุระหว่างชั้นของการทำลามิเนชันทำให้สามารถเพิ่มค่าทางไฟฟ้าได้เป็นอย่างดี ฟิล์มโพลีไวนิลลิดีน ฟลูออไรด์พอลิเมอร์ และ ฟิล์มคอมโพสิต (composite film) ของพอลิไวนิลลิดีน ฟลูออไรด์กับสารประกอบเซรามิก แบเรียม สตรอนเทียม ไททานเนท ($\text{Ba}_{0.7}\text{Sr}_{0.3}\text{TiO}_3$) ถูกนำมาใช้ในการทำลามิเนตฟิล์ม (laminated film) โดยวิธี compression molding สารประกอบเซรามิก แบเรียม สตรอนเทียม ไททานเนท ถูกสังเคราะห์ด้วยวิธีโซลเจล ฟิล์มพอลิไวนิลลิดีน ฟลูออไรด์โพลิเมอร์ ถูกเตรียมด้วยวิธี solution-casting technique และจากการตรวจสอบ ด้วยเทคนิค ฟลูออโรสโคปอินฟราเรด สเปกโตรสโคปี (FTIR) พบว่า ผลึก β (β -crystalline phase content) มีค่าสูงสุดถูกพบใน ฟิล์มโพลีไวนิลลิดีน ฟลูออไรด์ ที่ไม่ได้ถูกดิ่ง แต่จะมีค่าลดลงในฟิล์มที่ถูกดิ่งในอัตราส่วนที่เพิ่มขึ้น อย่างไรก็ตามฟิล์มที่ถูกดิ่งในอัตราส่วนที่เพิ่มขึ้นมีการสูญเสียทางด้านการเก็บประจุที่ดีขึ้น ปริมาณสารประกอบเซรามิก แบเรียม สตรอนเทียม ไททานเนท ที่เพิ่มขึ้นในฟิล์มคอมโพสิตช่วยเพิ่มค่าไดอิเล็กทริก (dielectric constant) ได้เป็นอย่างดี ค่าไดอิเล็กทริกของลามิเนตฟิล์ม เป็นไปตาม รูปแบบการต่อวงจรการเก็บประจุไฟฟ้าแบบอนุกรม นอกจากนี้ลามิเนตฟิล์มยังมีคุณสมบัติเฟอร์โรอิเล็กทริก (ferroelectric behavior)

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