UNIVERSITI TEKNOLOGI MARA

FABRICATION OF $PbTiO_3$/PVDF-TrFE ORGANIC THIN FILM CAPACITORS

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Thesis submitted in fulfillment
of the requirements for the degree of
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AUTHOR'S DECLARATION

I declare that the work in this thesis was carried out in accordance with the regulations of Universiti Teknologi MARA. It is original and the result of my own work, unless otherwise indicated or acknowledged as references work. This thesis has not been submitted to any academic institution or non-academic institution for any degree or qualification.

I, hereby, acknowledge that I have been supplied with the Academic Rules and Regulations for Post Graduate, Universiti Teknologi MARA, regulating the conduct of my study and research.

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ABSTRACT

This study presents a new dielectric material utilized for thin film organic capacitors. It consists of a combination of organic and inorganic ferroelectric materials, namely lead titanate ($PbTiO_3$) and polyvinylidene fluoride trifluoroethylene (PVDF-TrFE). In most ceramic-polymer dielectric films, the combination of $PbTiO_3$ and PVDF-TrFE as a form of bilayer configuration has never been explored. The study highlights that with a presence of PVDF-TrFE as a second layer, the dielectric and ferroelectric property of $PbTiO_3$ thin film improved. In this study, the dielectric thin films were prepared using a simple and cost-effective method of sol-gel spin coating. The deposition parameters for the synthesized $PbTiO_3$ thin film was optimized at 0.4 M solution concentration, 10 wt% of excess Pb content, and annealed at 550°C. Subsequently, the optimized $PbTiO_3$ thin film was utilized as a novel bilayer structure of $PbTiO_3$/PVDF-TrFE film. The film demonstrated high dielectric permittivity value ($\varepsilon_r \approx 217$) and low tangent loss ($tan\ (\delta) \approx 0.0017$). In addition, the film has showed tremendous enhancement of remnant polarisation ($P_r = 18.66\ \mu C/cm^2$), which is three times higher than a single $PbTiO_3$ thin film. The new approach of parallel capacitor design is the highlight of this study and managed to produce high capacitance value ($C \approx 13.4\ nF/cm^2$). To date, this is a notable achievement of the dielectric and ferroelectric properties for bilayer dielectric film as none of this finding has been declared, so far. Hence, a novel bilayer structure of $PbTiO_3$/PVDF-TrFE film can be a promising candidate for high capacitance thin film capacitors.

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