UNIVERSITI TEKNOLOGI MARA

ENHANCED DIELECTRIC PROPERTIES OF FILLED PVDF/MGO POLYMER NANOCOMPOSITE

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Thesis submitted in fulfilment
of the requirement for the degree of
Master of Science

Faculty of Applied Sciences

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CONFIRMATION BY PANEL OF EXAMINERS

I certify that a Panel of Examiners has met on 29th April 2015 to conduct the final examination of Adillah Nurashikin binti Arshad on her Master of Science thesis entitled "Enhamced Dielectric Properties of Filled PVDF/MgO Polymer Nanocomposite" in accordance with Universiti Teknologi MARA Act 1976 (Akta 173). The panel of Examiners recommends that the student be awarded the relevant degree. The panel of Examiners was as follows:

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AUTHOR'S DECLARATION

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

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ABSTRACT

PVDF and PVDF/MgO nanocomposite thin films (MgO loading percentages 1, 3, 5, 7, 9 and 11 .wt%) were produced by spin coating on Al-glass substrates at 1500rpm. PVDF thin films were annealed subsequently at 70°C, 90°C, 110°C, 130°C, 150°C and 170°C, and then were cooled by fast cooling (FC) and slow cooling (SC). PVDF thin films annealed at 70°C with SC resulted an increment in the dielectric constant from 10 (UN-PVDF) to 14 at 1 kHz frequency with low tangent loss of 0.05 (UN-PVDF = 0.1). An increased in the resistivity value of $3.2x10^4$ Ω.cm (UN-PVDF = $2.0x10^4$ Ω.cm) was also observed. Upon incorporation of MgO nano-filler, PVDF/MgO(7%) nanocomposite thin film showed highest dielectric constant of 22 at similar frequency compared to UN-PVDF (10), with low dielectric loss (ε"= 0.08), as well as an increase in resistivity value in comparison to PVDF/MgO film of 1, 3, 5, 9 and 11 wt% MgO loading. Most importantly, PVDF/MgO(7%) nanocomposite thin film was found to be free from defects such as voids as evident from FE-SEM images of the films. The broad significant bonding peaks at 840 and 880 cm^{-1} as observed from the FTIR spectrum were representations of the -CH_2 and -CF_2 groups of PVDF film with an indication of high content of β-phase crystals, which contributed to an increment in the dielectric constant of PVDF/MgO(7%) nanocomposite thin films. Hence, by utilizing this two parameters, PVDF/MgO(7%) nanocomposite thin films and then annealed at 70°C with SC, resulted in the highest dielectric constant value of 27 for this study, with small increased in tangent loss of 0.13 at 1 kHz frequency. Resistivity value of annealed PVDF/MgO(7%) was also observed to increase ($10.5x10^4$ Ω.cm). Thus, it was concluded that PVDF/MgO(7%) annealed at 70°C, and then cooled slow cooling was the optimized parameter conditions required for producing high dielectrics properties of PVDF nanocomposite thin films.

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