High-k modified graphene/polymer nanocomposite for thin film capacitor applications

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Abstract

With the increased market demand of embedded and micro capacitors, the research of high-k dielectric materials has drawn more attention in recent years [1]. Nanocarbon such as graphene and carbon nanotubes has been applied as nanofiller for high k polymer nanocomposite [2]. In this work, TiO_2 surface modified reduced graphene oxide(rGO) was applied as nanofillers for poly(vinylidene fluoride) (PVDF) matrix. According to the results, the dielectric constant of the nanocomposite at 10Hz increases from 20.27217 to 37.91446 as the increase of rGO-TiO_2 concentration from 0.2 to 1.0 wt%, which increases by 102.72% to 279.14% compared with pure PVDF. In addition, the results of electrochemical Impedance spectroscopy (EIS) demonstrate remarkable charge transfer resistance of PVDF/rGO-TiO_2 nanocomposites corresponding to decreased leak current and great capacitance of the dielectric capacitors. This nanocomposite also shows acceptable dielectric loss and good breakdown strength. With 0.2 wt% of rGO-TiO_2 nanofillers, the breakdown strength improves 8.94% compared to pure PVDF. The addition of rGO-TiO_2 nanofillers into PVDF leads to increased dielectric constant at broad frequency range from 10 to 10^6 Hz.

References

[1] Chen, L., Xiao, W., Journal of Functional Materials, 49(6) (2018) 6064-6072
[2] Mohammed H Al-Saleh, Nanotechnology, 30 (06) (2019) 2001

Figures

Figure 1: Schematic illustration of the synthesis mechanism of rGO-TiO_2 nanoparticles.

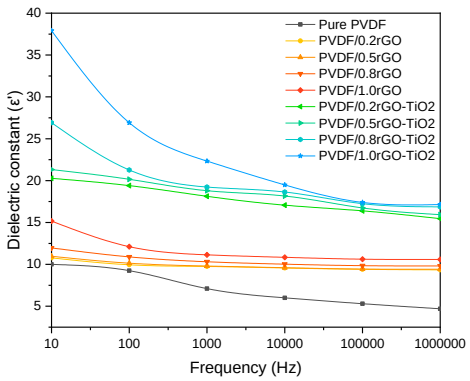

Figure 2: Dielectric constant of PVDF/rGO and PVDF/rGO-TiO_2 compared to pure PVDF.