



## Low-value polymeric thin-film capacitor

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An polymeric-capacitor was fabricated using the poly(butylene adipate) (PBA) and fabricated device was electrically characterized. C-V and transient response characteristics were determined. The capacitance and time constant of the polymeric-capacitor are found as 17.5 pf and 13.75 ns. The RC filter circuit was applied to polymeric-capacitor and was investigated the low-pass output frequency characteristics and the low-pass filter transient response.

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### 1. Introduction

Capacitors are important elements in electrical circuits, although they tend to be more bulky than other elements, such as resistors, diodes and transistors, and their high-frequency performance remains an issue [1]. Capacitors made by using various dielectric materials and different input materials differ considerably in their efficiency for various types of applications. The capacitance and voltage ranges for various dielectrics have limitations due to inherent characteristics. At present many microelectronic devices are stretching their limits towards miniaturization the capacitance density and the size of the capacitor [2]. It is well known that an electronic device consists of various functional parts. When a dielectric material is sandwiched by electrically conductivity layers and an insulating layer, a capacitor is constituted. A polymeric or an organic compound and a ceramic can be used as a dielectric material. Thus, capacitors based on dielectrics are important for electronics. The discovery of conducting and semiconducting polymers is the most important development in the polymer science. These polymers are structural materials which are important for many applications including microelectronics, optical sensors, light-emitting devices and Schottky diode devices. The ability of these polymers to serve as capacitors is itself the electronics. The polymers as capacitors can be used to

store electrical energy. The possibility of processing electrical conducting polymers by various coating techniques has enabled researchers to fabricate various electronic devices such as thin-film transistors, diodes, LEDs, capacitors, organic integrated circuits, organic wires, and electro-luminescent devices [3-8]

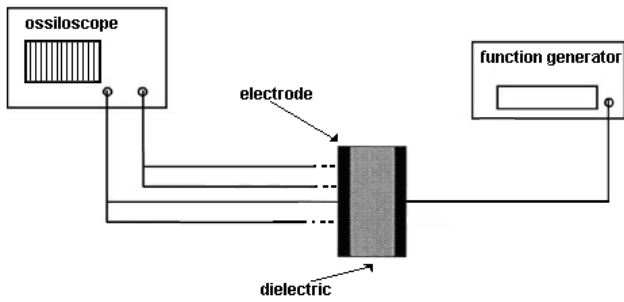
In this communication, the aim of this work is to fabricate a polymeric capacitor and investigate characteristic properties.

### 2. Experimental

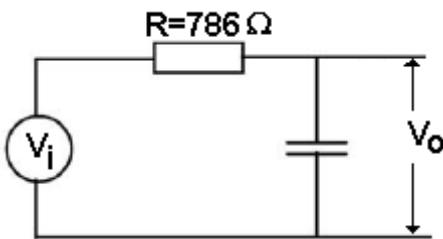
#### 2.1. Preparation of the capacitor and measurements

The poly(butylene adipate) (PBA) were described elsewhere [9]. The Polymer was deposited by solution casting onto an Al foil. Al-oxide layer was constituted on the Al foil by anodic oxidation method. This layer provides a charge carrier barrier between ionomers and Al electrode. A second electrode was made on the other surface by means of silver paint. The scheme of the capacitor and experimental setup for RC filter is shown in Fig. 1. Equivalent circuit for R-C filter is also shown in Fig.2. The capacitance-voltage (C-V) and transient characteristics of the polymeric capacitor were

performed using a FYTRONIX Electronic Device Characterization system.



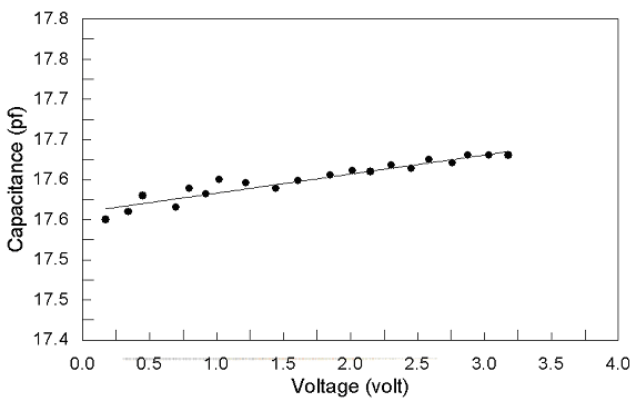
**Fig. 1** The scheme of the capacitor and experimental setup for RC filter



**Fig. 2** .Equivalent circuit for R-C filter

**3. Results and Discussion**

Fig. 3 shows capacitance-voltage (C-V) plot of the polymeric-capacitor. A linear voltage is applied to the polymeric-capacitor by probing the control electrodes from a two-channel controllable power supplier.

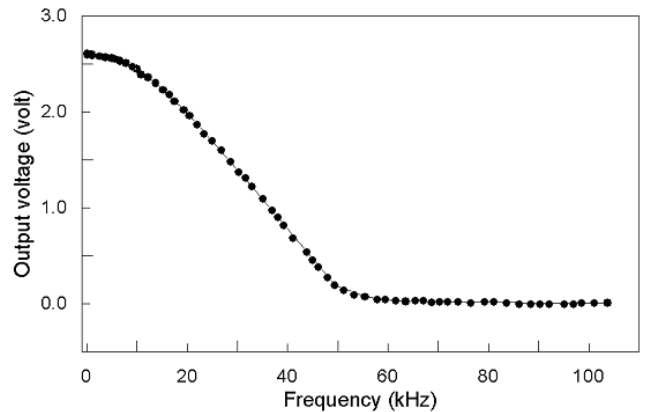


**Fig. 3.** Plot of C-V of the polymeric-capacitor

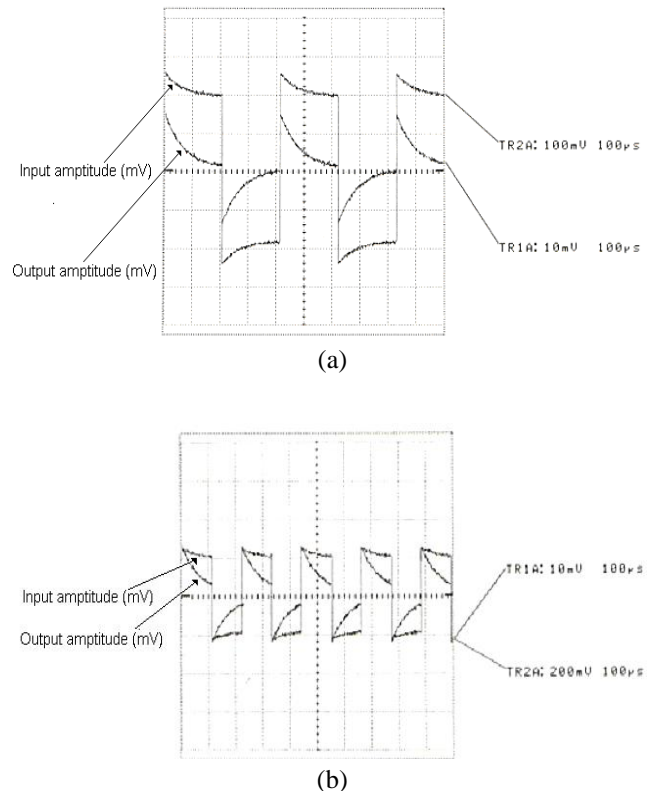
It can be seen that the capacitance was not affected significantly by the electric field. A flat region was observed and in this region, capacitance increased almost linearly. This behavior is observed in the curve of typical parallel plate capacitors [2]. This suggests that the accumulation rate of charge carriers at the top and bottom electrode is the same. From this figure, the capacitance of the polymeric-

capacitor is 17.5 pf. The relaxation time for the capacitor was found as  $\tau=13.75$  ns.

We have applied resistance-capacitor (RC) filter circuit to the polymeric-capacitor. For the RC filter, the resistance is 786 (see Fig.2). An decrease in output voltage of the polymeric-capacitor is observed with the increasing frequency. A square wave at the 2.47 and 4.57 kHz frequencies was applied to polymeric-capacitor. Figs. 4 and 5(a-b) show the low-pass output frequency characteristics and the low-pass filter transient response, respectively.



**Fig. 4** The variation of output voltage with frequency



**Fig. 5** The low-pass filter transient response of the polymeric capacitor for different frequencies a) 2.42 kHz b) 4.57 kHz

The low frequency -pass filter passes low frequencies depending on values of resistance and capacitance used and

the filter does not pass high-frequencies. The half-power frequency in which ratio of output power to input power is 0.71. The half-power frequency was calculated from the Fig. 4 and was found as 22.72 kHz.

#### 4. Conclusion

The low-value polymeric thin film capacitor was found to be a parallel-plate capacitor with capacitance 17.5 pF and its time constant is 13.75 ns. The polymeric capacitor studied here can be used the low-cost polymer IC circuit industry.

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