11th International Conference on Advanced Materials
ICAM 2009
Rio de Janeiro Brazil
September 20 - 25

Study of KDP Concentration in a PEDOT: PSS matrix at Voltage x Pressure Response

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Abstract – In this work we studied the mixture of Poly(3,4-ethylenedioxythiophene):poly(styrenesulfonate) (PEDOT: PSS), a commercial polymer, with monobasic potassium phosphate (KDP), a piezoelectric salt, as a novel material in the fabrication of a low cost, easy-to-make, flexible pressure sensing device. Afterwards, a impulsive pressure-response experiment was performed. The results showed that the material has responses to pressure directly applied to the sample that can be useful in the fabrication of sensors, and a field effect transistor will be made using this material.

Organic semiconductors based on conjugated polymers offer an opportunity to produce devices with wide area and low cost on flexible substrates [1]. Monobasic potassium phosphate (KDP) is a piezoelectric material with two constants, one in the distance d_{25} and the other, the stronger, in the distance d_{36}, with a value of 69.6 x 10^8 at 20^o C [2]. The conductive polymeric system (PEDOT: PSS) was mixed with KDP in this work. The PEDOT: PSS system has a relatively high conductivity, and highly soluble in water, making it an interesting system to be mixed with the high-soluble KDP. The mixtures were prepared according to the reference 3 and were deposited in polyester sheets with a spincoater. After that, a impulsive pressure-response experiment was performed.

In the experiment was observed that the non-polarized samples responded to the pressure when the pressure source was released, and then declining rapidly. Of the tested samples, the ones above 50mg of KDP in the mixture showed some kind of reaction to applied pressure. Figure 1 shows a curve of pressure versus voltage obtained for the 50, 60 and 100mg of KDP in 5ml of PEDOT: PSS sample.

The 50 mg sample showed a increase in the mean voltage obtained until 4.1 kpsi, above this pressure the sample as physically distorted making impossible further measurements. For the 60 mg sample it was observed that until a pressure of 3.1 Kpsi, the average voltage increases, decreasing rapidly when applied a higher pressure, in that point it may have reached the sample´s saturation point. There the value average voltage is below of other values and the sample was physically distorted, also it was not possible to do the experiment for values of pressure higher than 4.1 Kpsi. To 100mg of KDP was observed initially that the change in voltage measured is low at the beginning of the experiment and increases with increasing pressure, not showing possible signs of saturation at higher pressures, and this variation can be observed for pressures higher than 4.1 kpsi.

The presented behavior indicates the ability of the material in response to pressure by means of its electrical properties. A more detailed study on the direction in which the KDP crystals are formed (figure 2) and their disposal in the film, since the direction in which pressure is applied influences the magnitude of the response obtained by tests, may explain the differences observed between the results for the samples.

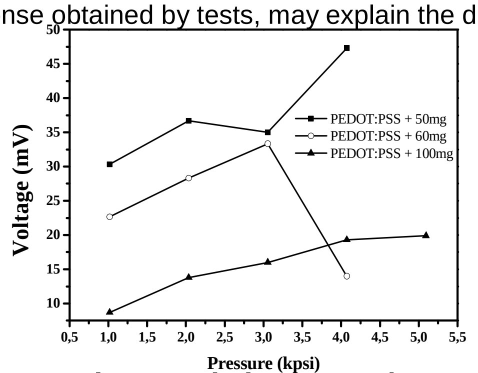

Figure 1: Voltage x applied pressure to the 50, 60 and 100mg of KDP sample.

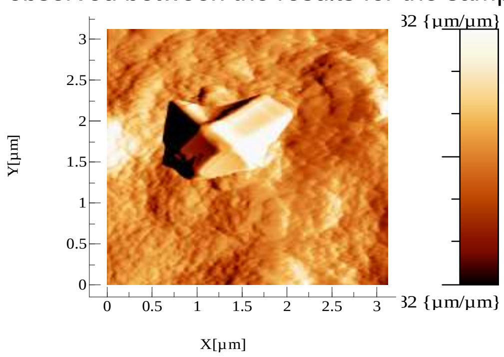

Figure 2: Atomic force microscopy (AFM) of a KDP crystal growing in a PEDOT:PSS matrix.

References

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