Growth of ZnO nanorods on reduced graphene oxide/ITO/PET by inkjet printing and their piezoeletric properties

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Introduction

A great amount of researches have been made about nanogenerators of energy based on zinc oxide (ZnO) nanostructures and their application in nano and microdevices. ZnO is a semiconductor material with band gap of 3,37 eV and a exciton binding energy of 60meV that shows piezoelectric properties when its nanostructures are subject to an external force.

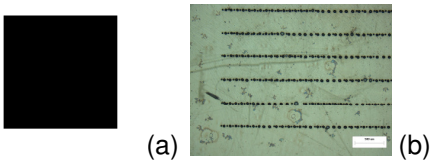
In the same way, graphene and reduced graphene oxide (rGO) show excellent properties like high conductivity, resistance and great surface area. For this, these materials have showed many applications on electronic devices.

By join these two materials it may be possible to improve the electric and mechanical properties of the nanodevices.

In this work, the inkjet printer (Dimatix® Drop Manager) is used to deposit a seed layer by using zinc acetate and rGO inks with a pattern on flexible substrates. After that, ZnO nanostructures were grown by chemical bath deposition (CDB) at lower temperature. The piezoelectric properties of the nanostructures were investigated by electrical response when these nanostructures were submitted to different frequency of vibration.

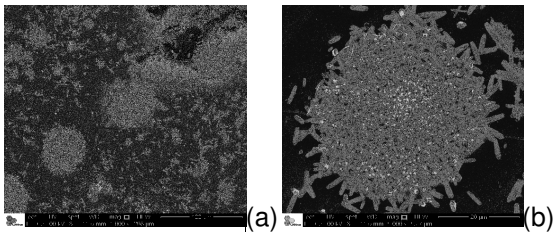
Results e Discussions

The images on Figures 1 and 2 show the steps of the process to produce the ZnO nanorods. It is possible to see the growth ZnO nanorods on rGO/flexible substrates with a specific pattern by using simple methods.



(a) (b)

Figure 1. (a) Pattern design; (b) Optic microscopy image after deposition of acetate ZnO seed layer on PET/ITO substrate.



(a) (b)

Figure 2. (a) SEM image after seed layer printer and growth of ZnO nanords on rGO/PET/ITO substrate ; (b) SEM image after printer and growth of ZnO nanords on PET/ITO substrate (closer view).

The device prepared showed maximum potency value in 60 Hz (Figure 3) that implies its use as nanogenerators of energy.

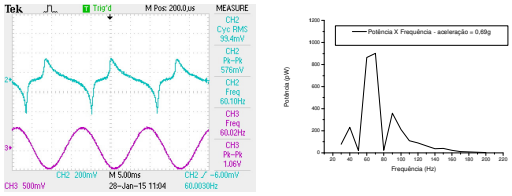


Figure 3. (a) Wave form, ressonance frequency of ZnO nanorods ; (b) Graphic Potencial x Frequency of the device.

Conclusion

The inkjet printing technique is an improvement in the growth of well-aligned ZnO nanorods with a suitable pattern that allows to make nanogenerators of energy with great performance.

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