Influence of inductive effect in organic residuals content in IZO thin films and the performance on the behavior of MIS capacitors on plastic.

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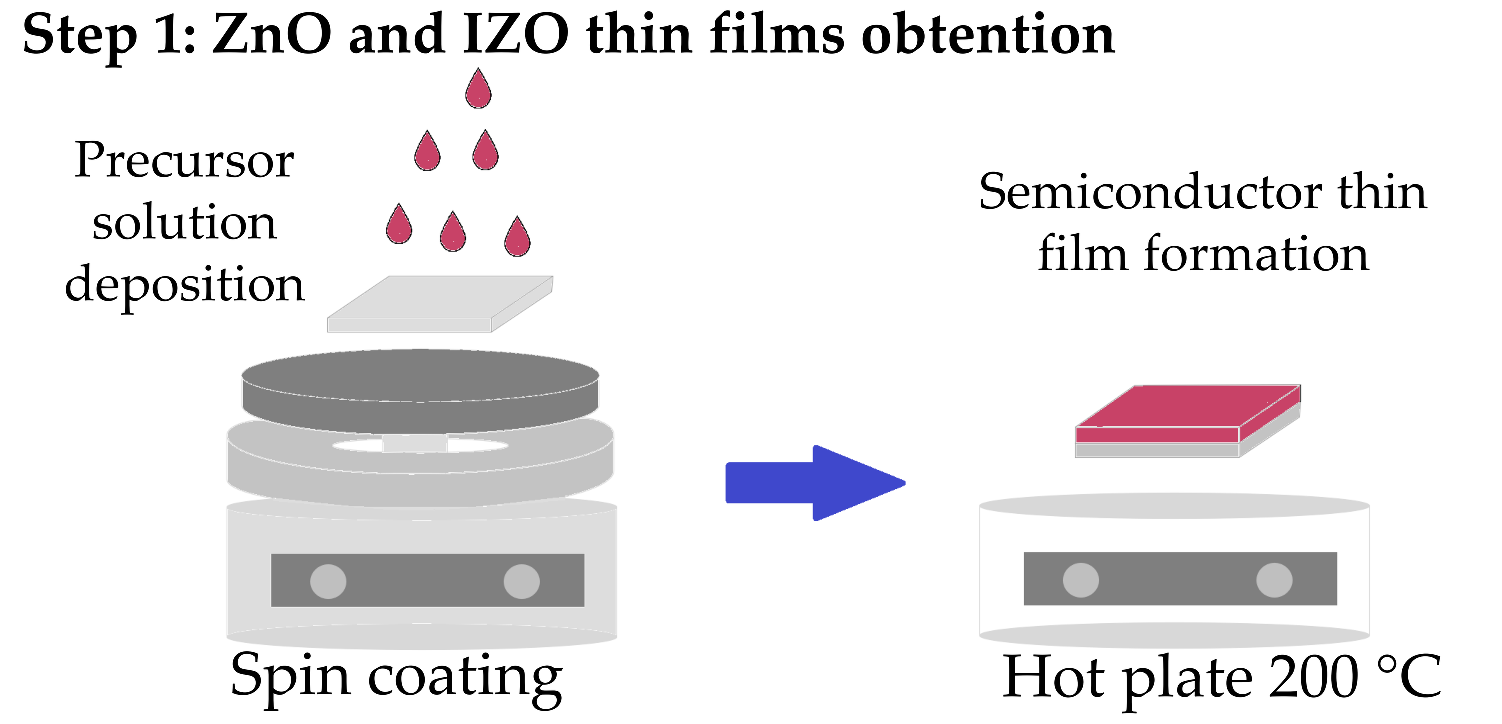
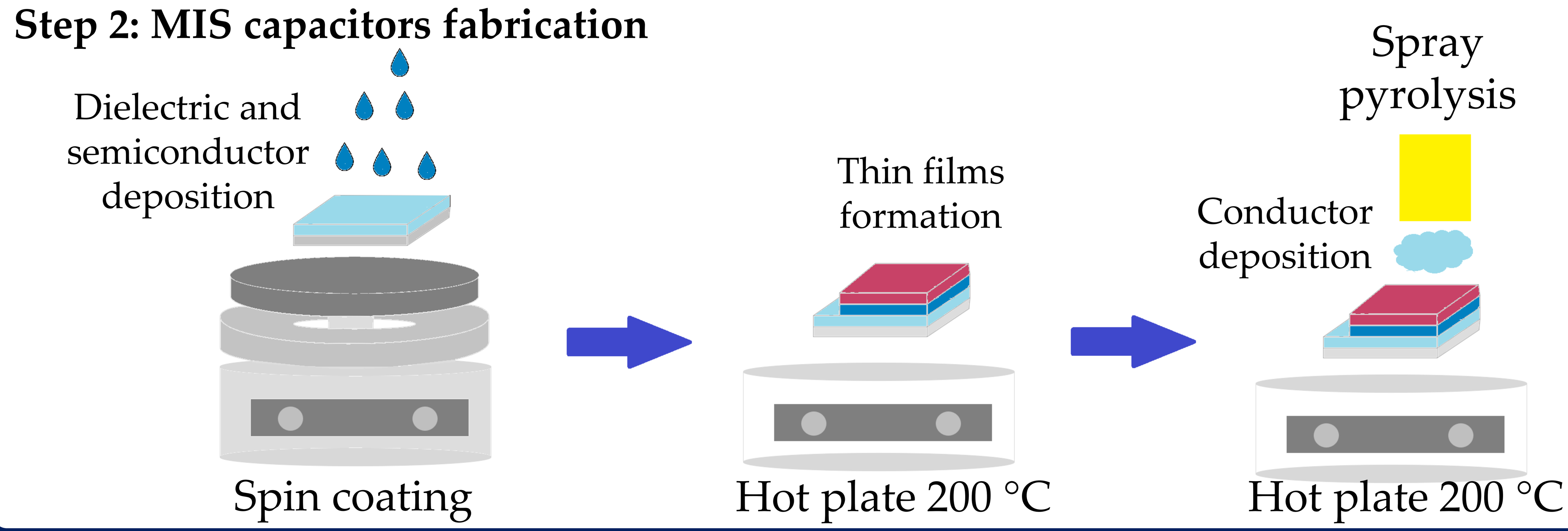
Metal oxide semiconductors are materials that can be easily handled to implement in polymeric substrates to flexible electronic applications [1]. For the formation of metal oxide semiconductors four phases occur in solution processes: 1) the synthesis or generation of precursor solution, 2) deposition, 3) pyrolysis or condensation and 4) crystallization [2]. The use of low temperatures (<200 °C) limits the decomposition of the precursor solution and thin films are formed with organic residues that act as traps and reduce the electrical properties of the films [3, 4]. The reduction of residues can be possible by variation of doping concentration in the precursor solution. In this work, the synthesis of indium doped zinc oxide (IZO) thin films at different doping concentration was obtained at 200 °C. It was observed that at a given doping concentration a remarkable reduction of organic residues present in the film was obtained. Through FTIR spectroscopy, it was found that a shift of the identify bonds was occurred by a possible inductive effect.

Metodology

Step 1: ZnO and IZO thin films obtention



Step 2: MIS capacitors fabrication



Results

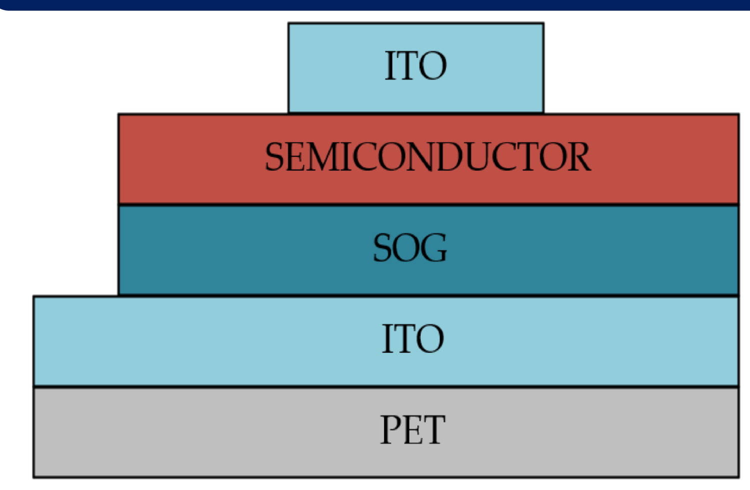


Figure 1. MIS Capacitor on plastic.

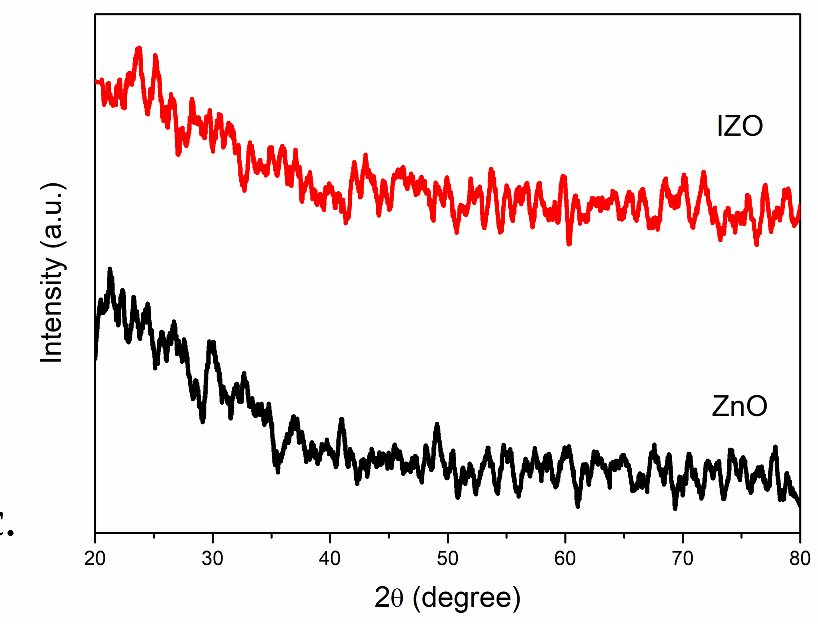


Figure 2. XRD patterns of ZnO and IZO thin films.

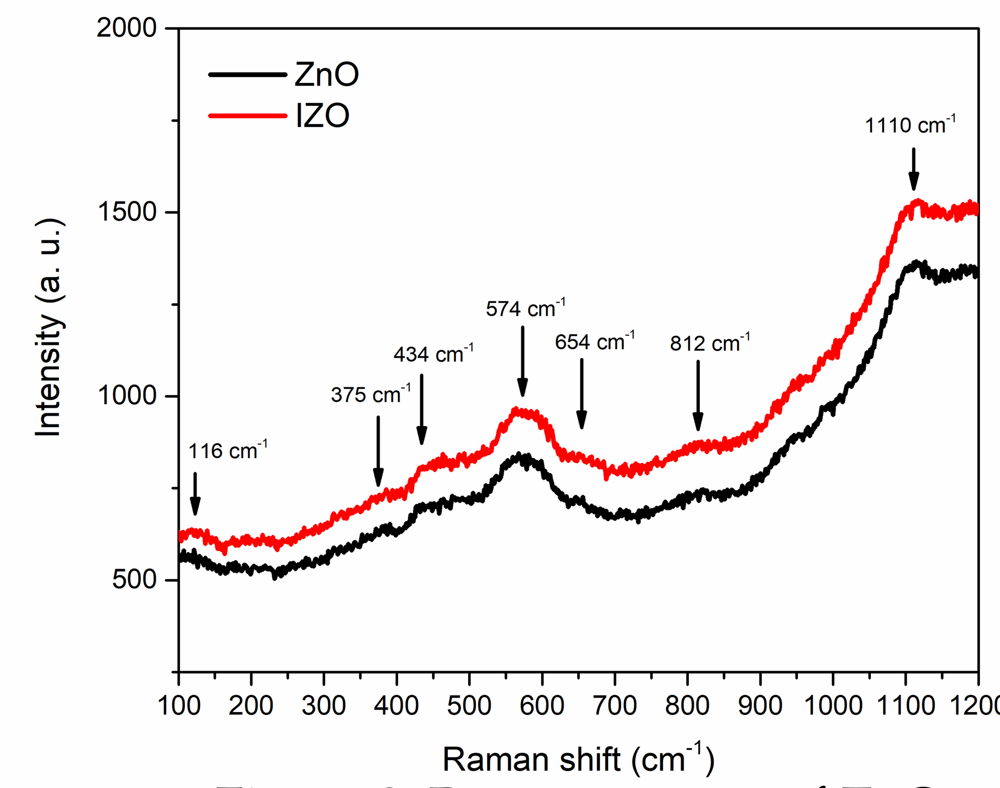


Figure 3. Raman spectra of ZnO and IZO thin films.

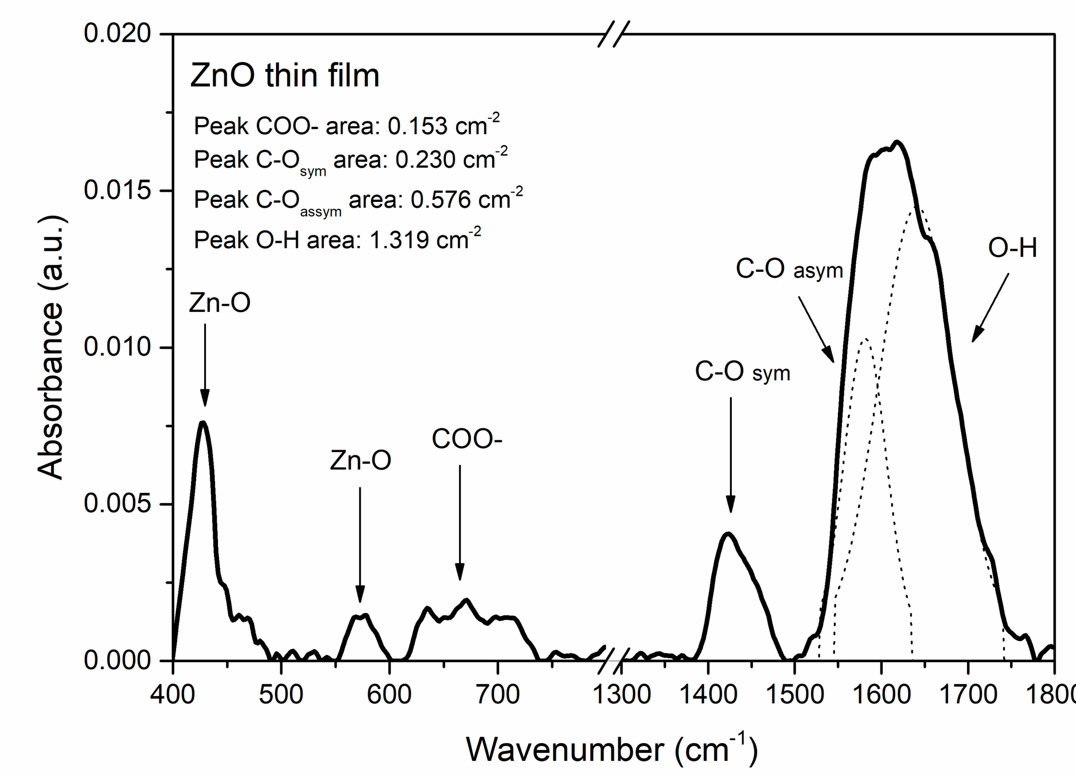


Figure 4. FTIR spectra of ZnO thin film.

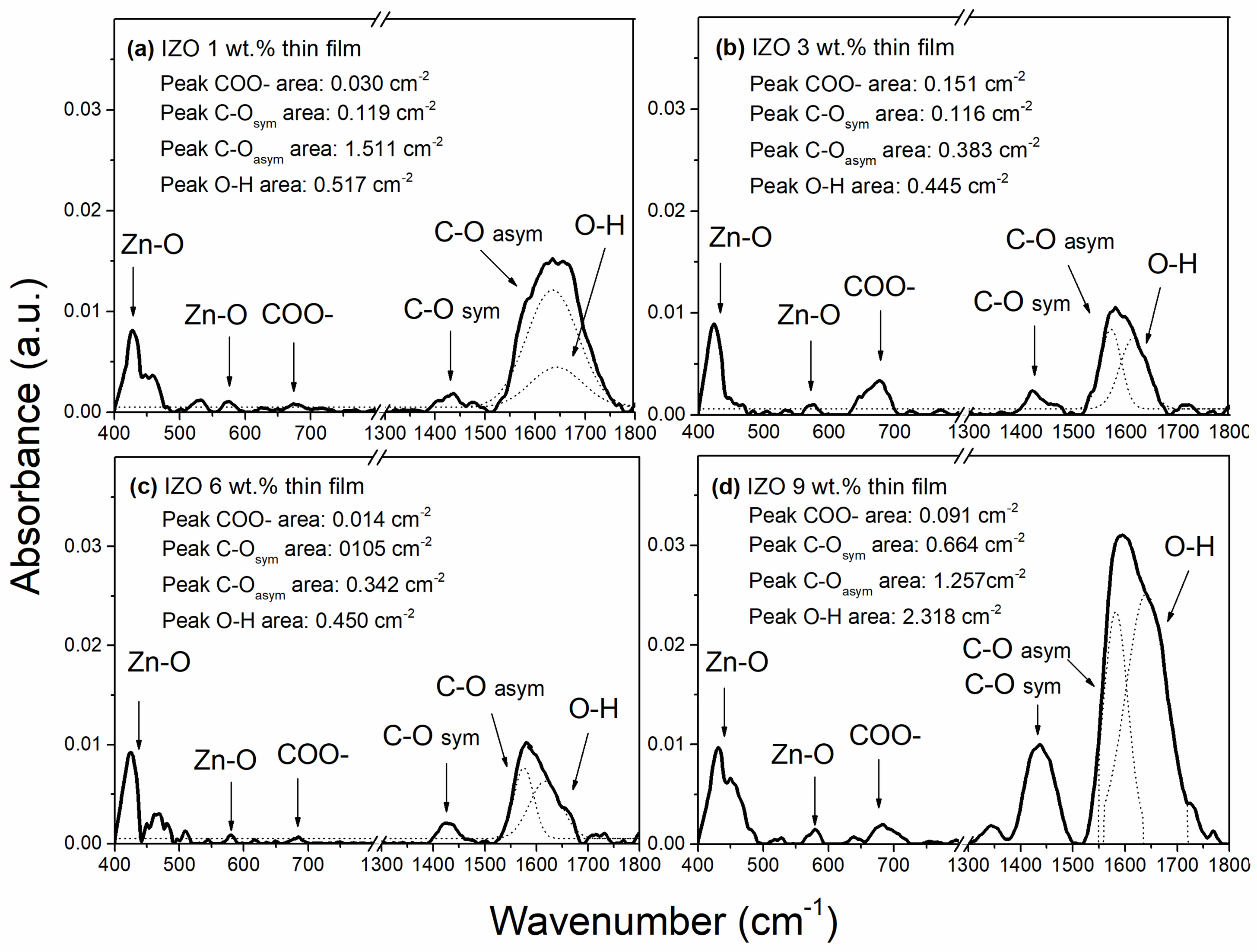


Figure 4. FTIR spectra of IZO thin films at different doping concentrations.

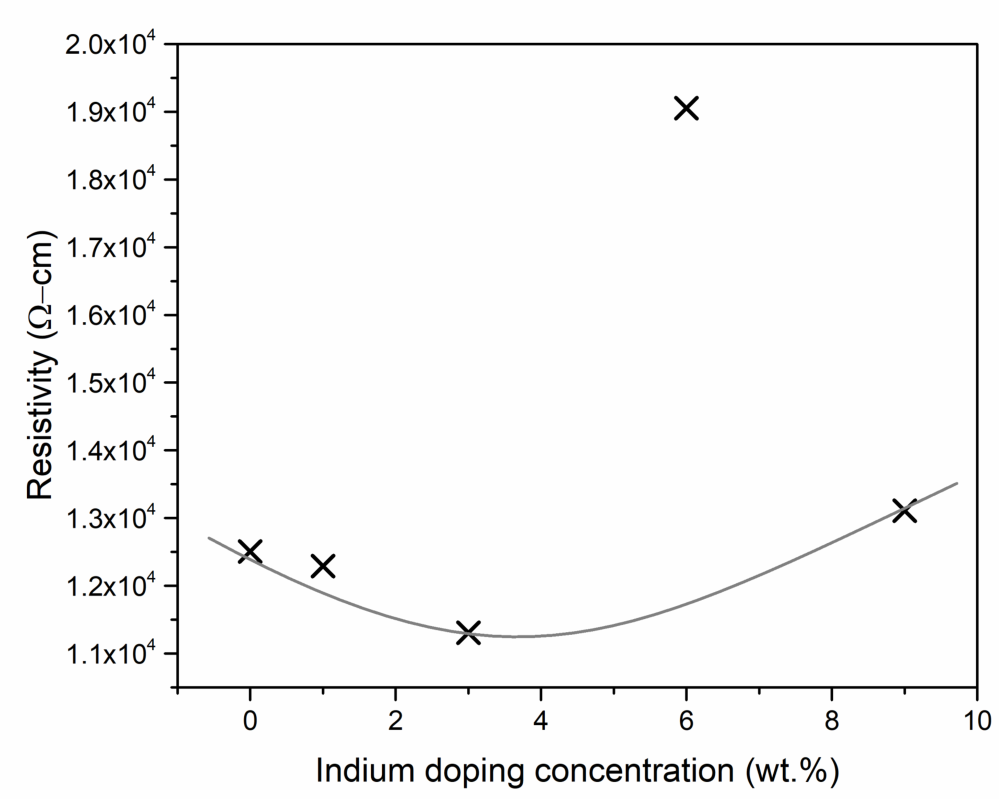


Figure 5. Resistivity of IZO thin films at different doping concentrations.

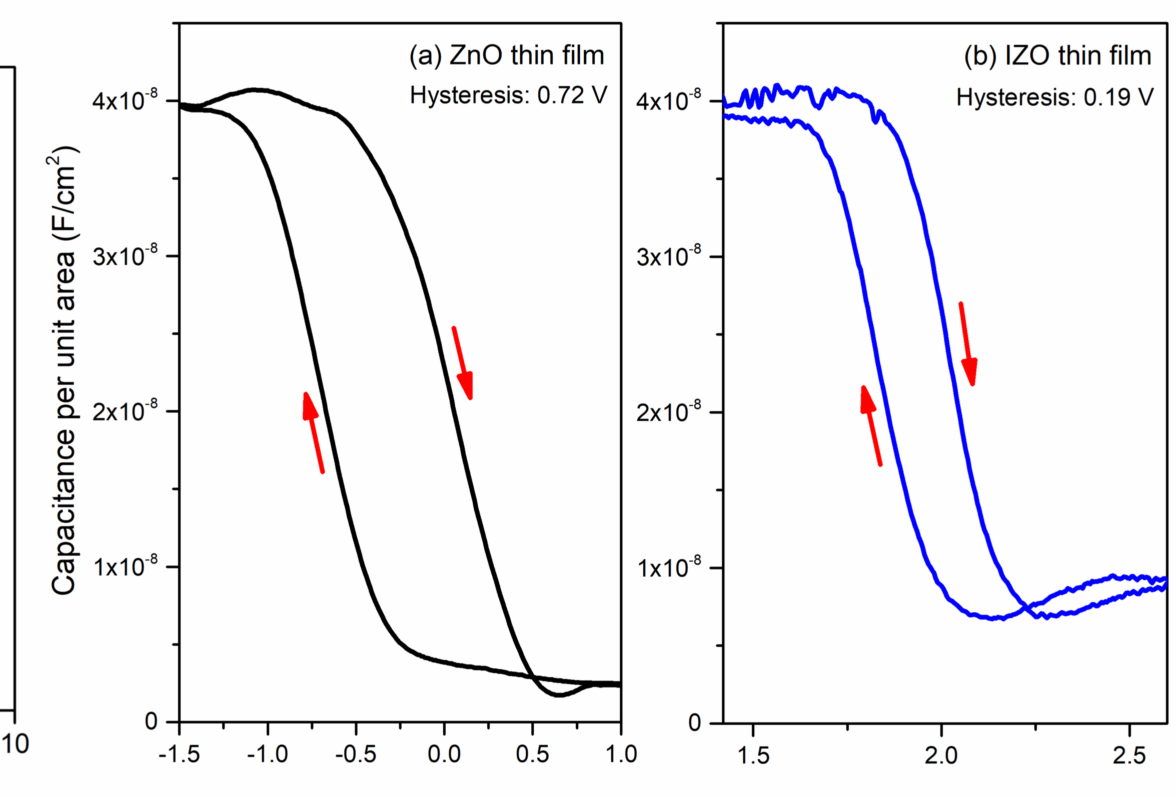


Figure 6. C-V curves of MIS capacitors on PET with (a) ZnO and (b) IZO semiconductor thin films.

Conclusions

- It was observed that the doped sample at 6 wt% showed a higher organic residues reduction.
- It has been observed that the concentration of dopant in ZnO contributes to the electrical behavior of the films obtained being favored due to the reduction of organic residues.
- In the fabricated capacitors, the C-V curve with the IZO film shows a reduction of the hysteresis compared with the undoped thin films. This is favored due to the reduction of organic residues present in the IZO thin film doped at 6 wt%.

References

1. Jo, J.-W.; Kang, S.-H.; Heo, J. S.; Kim, Y.-H. Park, S. K. Flexible metal oxide semiconductor devices made by solution methods. *Chem. Eur. J.* **2020**, 26, 9126, doi: 10.1002/chem.202000090
2. Bretos, I.; Jiménez, R.; Ricote, J.; Calzada, M. L. Low-temperature solution approaches for the potential integration of ferroelectric oxide films in flexible electronics. *IEEE T. Ultrason. Ferr.* **2020**, 67, 1967-1979, doi: 10.1109/TUFFC.2020.2995287.
3. Park, J.W.; Kang, B. H.; Kim, H. J. A review of low-temperature solution-processed metal oxide thin-film transistors for flexible electronics. *Adv. Funct. Mater.* **2020**, 30, 1904632, doi: 10.1002/adfm.201904632
4. Cheong, K. Y.; Mohammed, N.; Ramanan, S. Electrical and optical studies of ZnO:Ga thin films fabricated via the sol–gel technique. *Thin Solid Films*, **2002**, 410,142-146, doi: 10.1016/S0040-6090(02)00286-9