Metal oxide materials as a sustainable and viable alternative for low cost and high performance electronics

*E. Fortunato and R. Martins
CENIMAT/I3N and CEMOP-UNINOVA, Departamento de Ciência dos Materiais, Faculdade de Ciências e Tecnologia, Universidade Nova de Lisboa, Campus de Caparica, 2829-516 Caparica, Portugal
*emf@fct.unl.pt
Keywords: metal oxide materials; thin film transistors; solution process

Metal oxide electronic materials are quite attractive since they provide a large variety of different and possible applications due to the diverse spectrum of properties ranging from thin films to nanostructures.
Concerning applications they are becoming increasingly important in a wide range of applications like transparent electronics, optoelectronics, magnetoelectronics, photonics, spintronics, thermoelectrics, piezoelectrics, power harvesting, hydrogen storage and environmental waste management.
In terms of production tecnhiques rf magnetron sputtering has been well established and has demonstrated high performance devices, however these require complex high vacuum equipment which is a major drawback, especially if we are targeting low cost applications. In contrast, the solution process has many advantages such as large-area deposition, roll-to-roll capability, easy control of composition, atmospheric processing, and low cost (Fig.1) [3].
In this work we will present some advances on solution based conductors, dielectrics and semiconductors all based on metal oxide and their application to electronic devices.

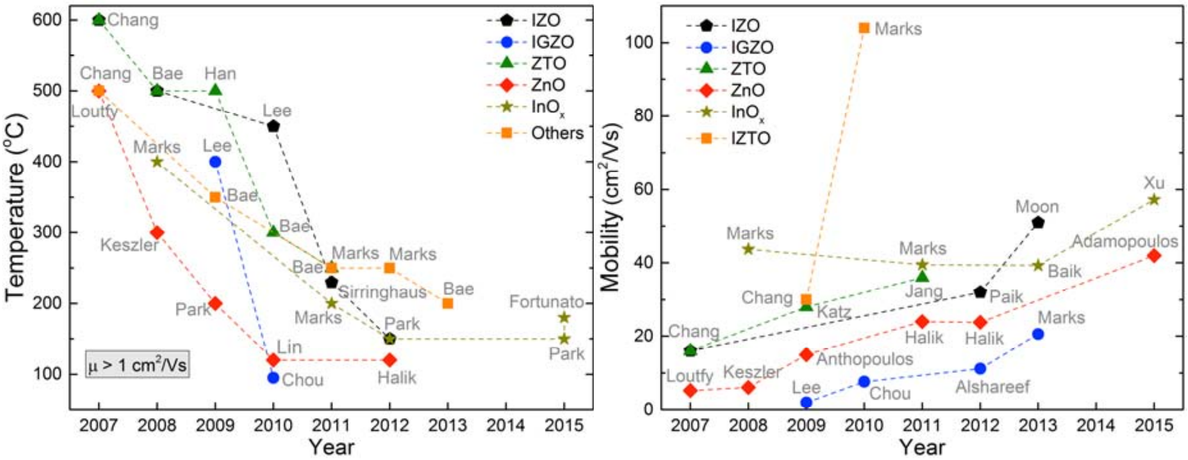

Fig. 1. Left graph) Evolution of the annealing/processing temperature of solution based TFTs over the last 10 years. We have plotted only TFTs presenting device mobility higher than 1 cm^2/Vs. Right graph) Evolution of device mobility of solution based TFTs over the last 10 years. Due to the high number of available papers (>500), we have plotted only the highest values reported for device mobility.

References

1) Lorenz, M.; Rao, M. R.; Venkatesan, T.; Fortunato, E.; Barquinha, P.; Branquinho, R.; Salgueiro, D.; Martins, R.; Carlos, E.; Liu, A., The 2016 oxide electronic materials and oxide interfaces roadmap. Journal of Physics D: Applied Physics 2016, 49 (43), 433001.

2) Liu, A.; Liu, G.; Zhu, C.; Zhu, H.; Fortunato, E.; Martins, R.; Shan, F., Solution- Processed Alkaline Lithium Oxide Dielectrics for Applications in n- and p- Type Thin- Film Transistors. Advanced Electronic Materials 2016, 2 (9).

3) Carlos, E.; Branquinho, R.; Kiazadeh, A.; Barquinha, P.; Martins, R.; Fortunato, E., UV-Mediated Photochemical Treatment for Low-Temperature Oxide-Based Thin-Film Transistors. ACS Applied Materials & Interfaces 2016, 8 (45), 31100-31108.

4) Salgueiro, D.; Kiazadeh, A.; Branquinho, R.; Santos, L.; Barquinha, P.; Martins, R.; Fortunato, E., Solution based zinc tin oxide TFTs: the dual role of the organic solvent. Journal of Physics D: Applied Physics 2017, 50 (6), 065106.