Metal oxide materials as a sustainable alternative to low cost and flexible electronics

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Metal oxide semiconductors are a good example as a success story in the area of thin film electronics, since it took less than 10 years after the discovery until the commercialization of the first products mainly in the area of displays. The main advantages of these materials are the low temperature processability, the high mobility and the uniformity over large areas, since they present an amorphous structure.
Nevertheless to decrease costs associated to electronic devices a strategy is using cheap and abundant materials in conjunction with low cost fabrication methods, associated to an overall increase of electrical performance. This is why metal oxide semiconductors are the key materials since they are chemically stable, mostly non-toxic and abundant materials, often manufactured by low cost methods, under ambient conditions. Consequently, devices made of metal oxides are inexpensive, very stable and environmentally safe, the 3 most important requirements for electronics.
Despite being explored for more than a century for electronic applications, from the initial works of Badeker in 1907 with CdO to the cutting edge IGZO available these days in active matrix backplanes of flat panel displays, oxides still present an exceptional and innovative combination of properties not achievable by any other material class. In fact, they are true multifunctional materials, being able to exhibit optical transparency, conducting / semiconducting / insulating behaviour, piezoelectricity and catalytic or self-cleaning properties among many others.
In this presentation we will review some of the most promising new technologies based on oxide conductors, semiconductors, dielectrics as well as electrochromic devices either in the form of nano-films or nanoparticles, and we will summarize the major milestones already achieved with this emerging and very promising technology focused on the work developed in our laboratory.
By using these materials and technologies we are contributing to the evolution of environmentally conscious electronics that is able to add new electronic functionalities onto surfaces, which currently are not used in this manner.

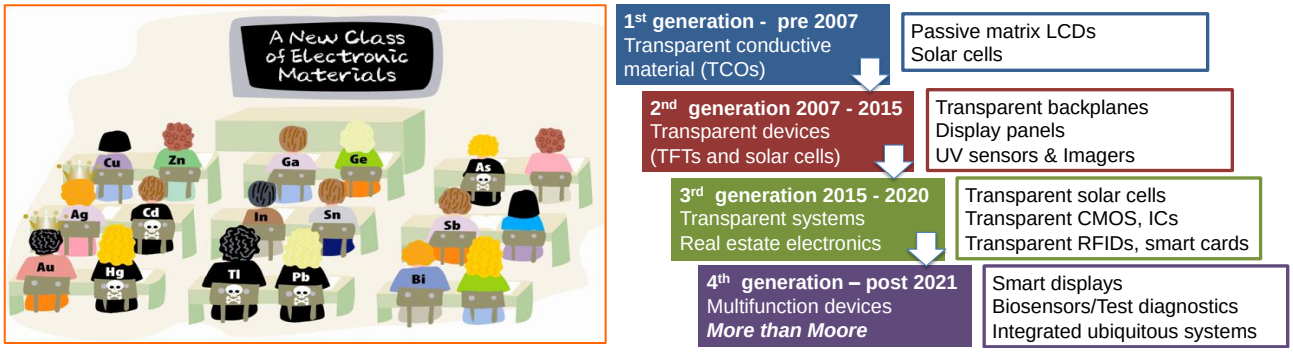

Figure 1. A comparison between a classroom and the new class of electronic materials based on metal oxides, by Prof. J. Wager from Oregon State University and the evolution of metal oxide materials.

References

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