The role of photochemistry in the low-temperature processing of solution-derived metal oxide thin films

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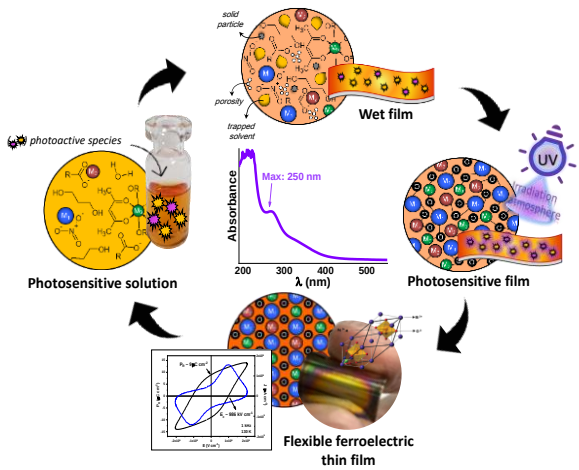
Nowadays, low-temperature thin film processes are being decisive in the development of the low-cost and lightweight flexible devices demanded by the emerging Flexible Electronics [1]. A flexible device has an active layer (functional film), which is integrated with a flexible substrate (plastic, rubber, or even paper). These substrates are characterised by their low-thermal stability. In this context, photochemistry is gaining attention in the field of inorganic chemistry because it has proven to be a powerful tool for the low-temperature preparation of metal oxide thin films on flexible substrates [2].

Solution-derived metal oxide layers contain molecules that can be excited by the photons coming from light sources. These photons penetrate into these layers and are consumed in the cleavage of chemical bonds and/or charge transfer processes within/among molecules or ions. Photoreactions also occur in the gas atmosphere where the film is irradiated. Here, the gas molecules are photolyzed, producing reactive radicals and new molecules, which are able to react with the thin film layer. All of these photo-processes activate the hydrolysis and condensation reactions in the amorphous solution-deposited layer, resulting in an advance of the crystallization of the metal oxide, without the need of applying a thermal annealing at a high temperature.



This presentation shows an overview to the different solution strategies that our group has developed for the low-temperature fabrication aided by photochemistry, of crystalline metal oxide films (see Figure) [3]. These approaches use UV-light as an alternative energy source to induce the crystallization of the oxide at a low temperature. The efficiency of these UV-assisted solution methods for the low-temperature crystallization of metal oxide films on plastics is demonstrated for materials like the multiferroic $BiFeO_3$, the ferroelectric $Pb(Zr,Ti)O_3$ or the photocatalytic β-Bi_2O_3.

[1] I. Bretos, R. Jiménez, J. Ricote, M.L. Calzada, *Chem. Soc. Rev*., **2018**, *47*, 291–308.
[2] I. Bretos, R. Jiménez, J. Ricote, M.L. Calzada, *Chem. Eur. J*. **2020**, *26*, 9277-9291.
[3] https://wp.icmm.csic.es/eosmad/labs-techs/low-temperature-thin-film-processing-lab/

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