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Towards anatase promotion in Cr (co-)doped TiO2 sputtered films

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Many applications of TiO_2 partially rely on its good performance as solvent for impurities [1]. In particular, metal (cation) dopants can functionalize or enhance TiO_2 as catalyst [2], diluted magnetic semiconductor [3] or transparent conductor [4]. Special attention has been devoted to TiO_2 photoactivity where doping has been extensively studied towards band-gap narrowing to achieve visible-light (VISL) response [2]. Metal doping (Cr,Mo,V…) can increase VISL absorption but introduces severe structural distortions that additionally result in carrier recombination centers [4]. Our research seeks for processing routes to improve the structural quality of Cr (co-)doped films produced by magnetron sputtering with emphasis in phase selectivity. Namely, the promotion of anatase is preferred due to the superior photoactivity of this phase or phase mixtures with high anatase content [5]. Recently [6], we have reported the impact of non-contact flash-lamp annealing (FLA) on monolithic TiO_2(:Cr) films. By tuning the energy flux, FLA yields customized TiO_2 phases but, in doped structures, phase formation only takes place for low Cr contents (< 5 at.%) and the rutile structure is mostly favored. On the contrary, modulated film architecture has shown promising results for anatase growth [7]. In this paper, such scheme, in conjunction with FLA, is explored in detail to optimize the film structural quality and growth design.

REFs: [1] Sacerdoti et al., J. Solid State Chem. 177, 1781 (2004); [2] Henderson, Surf. Sci. Rep. 66, 185 (2011); [3] Matsumoto et al. Science 291, 854 (2001); [4] Serpone et al., J. Phys. Chem. B 110, 24287 (2006); [5] Scanlon et al., Nat. Mater. 12, 798 (2013); [6] R. Gago, S. Prucnal et al., J. Alloys & Compounds 729 (2017) 438; [7] R. Gago, S. Prucnal et al., to be submitted.

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