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## Characterization and XPS analysis of Mn-doped calcium copper titanate thin films by a sol-gel method.

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Perovskite Mn-doped  $\text{CaCu}_3\text{Ti}_4\text{O}_{12}$  (CCTO) thin films were prepared by a sol-gel spinning method. The films were deposited one layer at a time and each layer was annealed at  $800^\circ\text{C}$  for an hour. Mn doping concentration in the films was varied in the range of 0-4 wt%. As the Mn doping concentration increases, the crystallite size decreases along with decreasing in the measured FWHM of X-ray peaks. From the FESEM micrographs, the grain size decreased to 20-30 nm with the increase of Mn content to 4 wt%. The high resolution XPS spectrum of Mn 2p of 4 wt% Mn-doped CCTO film show the existence of two different Mn ions,  $\text{Mn}^{3+}$  and  $\text{Mn}^{4+}$ . The Ca 2p regions in the XPS spectrum suggested that there are two environments for Ca atoms in the film structure. On the other hand, the XPS spectra of Ti 2p and Cu 2p regions show only the existence of  $\text{Ti}^{4+}$  and  $\text{Cu}^{2+}$ , respectively.

**Author:** Mr JOLUTSAKUL, Pachara (Department of Physics, Faculty of Science, Chulalongkorn University 254 Phyathai Road, Patumwan, Bangkok Thailand. 10330)

**Co-authors:** Mr PRAKENKRUNG, Sittichai (Department of Physics, Faculty of Science, Chulalongkorn University 254 Phyathai Road, Patumwan, Bangkok Thailand. 10330); Dr H.HODAK, Jose (DQIAyQF FCEN University of Buenos Aires/INQUIMAE-CONICET, Argentina); Dr K.HODAK, Satreerat (Department of Physics, Faculty of Science, Chulalongkorn University 254 Phyathai Road, Patumwan, Bangkok Thailand. 10330)

**Presenter:** Mr JOLUTSAKUL, Pachara (Department of Physics, Faculty of Science, Chulalongkorn University 254 Phyathai Road, Patumwan, Bangkok Thailand. 10330)

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