



Eötvös Loránd University

Wigner research center for physics



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Poster about:

Effect of silver (Ag) doping on optical, structural, and electrical properties of SnO₂ thin films.

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1. INTRODUCTION/PROBLEMATIC:
Transparent Conductive Oxides (TCOs) were discovered in 1907 when German scientist Karl Rauter discovered a thin film of cadmium oxide (CdO). Following this, scientists and researchers became interested in creating thin-film TCOs. This is because of its applications and importance. TCOs come in two varieties, known as n-type and p-type. Indium tin oxide (ITO) and fluorine tin oxide (FTO) are well-known n-type, while copper oxides and nickel oxides are p-type. Tin oxide (SnO₂) was doped with silver in this work because it has an electron in the lattice's valence orbit, this is interesting to determine what will happen to SnO₂'s physical properties by using a cheaper method Spray Pyrolysis Technique.

2. EXPERIMENTAL WORK:
• 1. Solution Preparation:
- Source of Tin(Sn): SnCl₄ 2H₂O
- Source of Silver(Ag): AgNO₃ dopant (0.3% Ag/Sn)
- 2:1 volume ratio of double-distilled water and methanol.
• 2. Spray Pyrolysis Technique:
Figure 1 - Photo of Spray Pyrolysis deposition system receiving inside SPFM.

3. CHARACTERIZATION TECHNIQUES:
• UV-Vis Spectrometry,
• X-Ray Diffraction,
• FT-IR Spectrometry,
• Four-Point Probe Method.

4. RESULTS AND DISCUSSION:
1. Optical properties: 1. Optical Transmission:
• Transmission is near 100% in wavelength visible light.
• The absorption region of all samples is caused by the transition between the E_{VB} and the E_{CB} is between 300 and 400 nm.
• The thickness of the sample is 400.6nm at 2.5%.
Figure 2 - Optical transmission plot of Ag (0.3 Ag/Sn%) doped SnO₂ thin films.

2. Optical Band Gap (E_g): Tauc relation:
 $(\alpha h\nu)^2 \sim h\nu - E_g$
Figure 3 - Tauc relation plots gathering the features of all samples.

5. CONCLUSION:
1) Monitoring of E_g from the first doping and its stability makes Ag/TO substrate AZO for tandem solar cells.
2) Most of the sample's growth is along the [110] direction.
3) The minimum value of R_{sh} is 5.93 (Ω/□) at 1.5% of Ag/Sn.
4) The maximum value of the figure of merit is 3.43x10⁴ (Ω⁻¹ cm⁻¹) at 2.5% of Ag/Sn.

5. FOR FUTURE STUDIES:
• Use of Ag/TO as anti-bacterial.
• Search for gases Ag/TO can be widely used.
• Co-doping of Tin Oxide with Ag and Fluorine.

REFERENCES
[1] B. Benkhanou, S. Abban, A. Rahal, A. Benkhanou, M. Aida, M. S. Effect of film thickness on the structural, optical and electrical properties of SnO₂ thin films prepared by spray pyrolysis for solar cells applications. Superlattices and Microstructures, 83, (P. 88(2018)).
[2] S.M. Al, S.T. Hussain, Sh. Abu Bakar, J. Muhammad, N. Rahman, Effect of doping on the structural and optical properties of SnO₂ thin films fabricated by aerosol assisted chemical vapor deposition. Journal of Physics: Conference Series, 676, 01, 2013, (2013).

Motivation:

- Transparent Conductive Oxides (TCOs) combine two properties: conductivity, and high transparency.
- In this work, tin oxide SnO₂ was doped with silver.
- Using a cheaper method Spray Pyrolysis Technique.

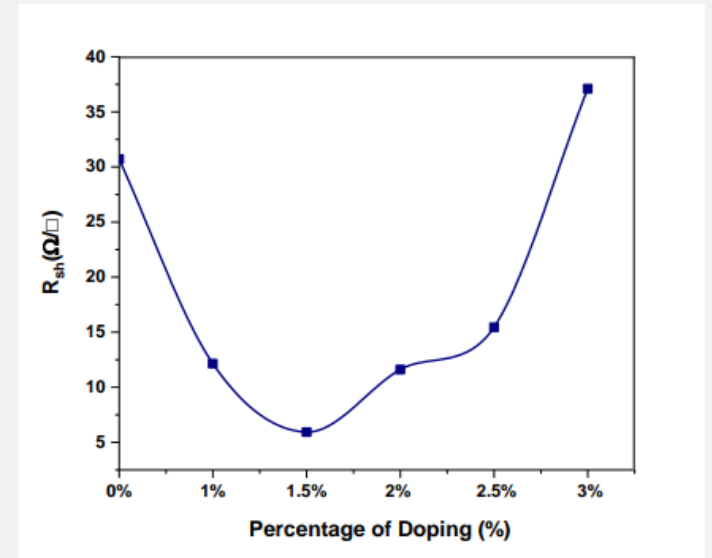


Fig.1: Draw of R_{sh} values of undoped and Ag 1-3 Ag/Sn % doped

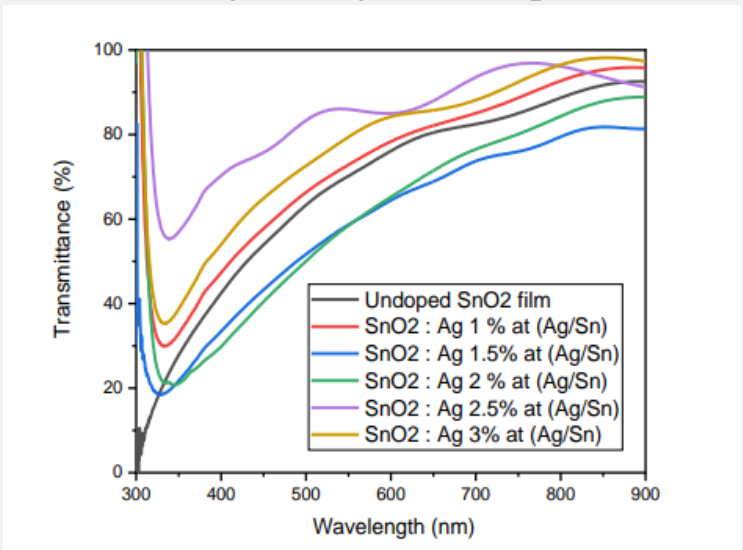


Fig. 2: Optical transmittance plot of Ag (0–3 Ag/Sn.%) doped SnO₂ thin films.

The Most Important Results:

1. Redshift of E_g from 3.76 eV to 3.07 eV.
2. The maximum value of the figure of merit is 1.427×10^{-2} (\square/Ω) at 2.5% of Ag/Sn doping.
3. Future studies will make AgTO substitute AZO for tandem solar cells.

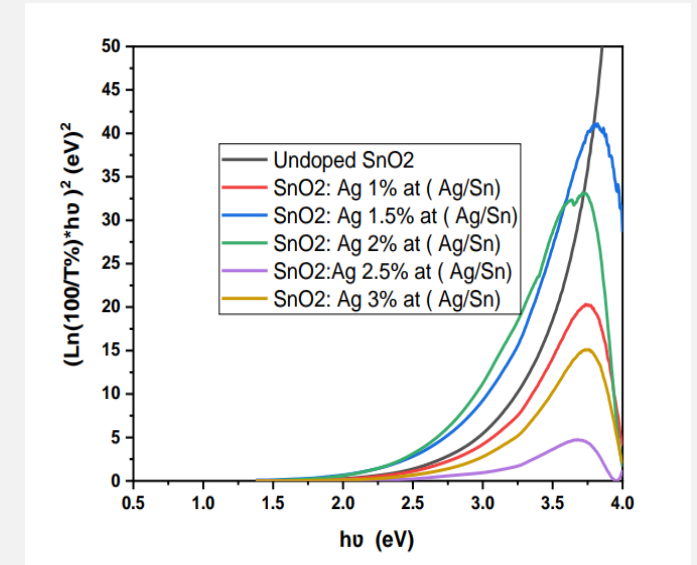


Fig. 3: Tauc relation plots gathering the features of all samples.

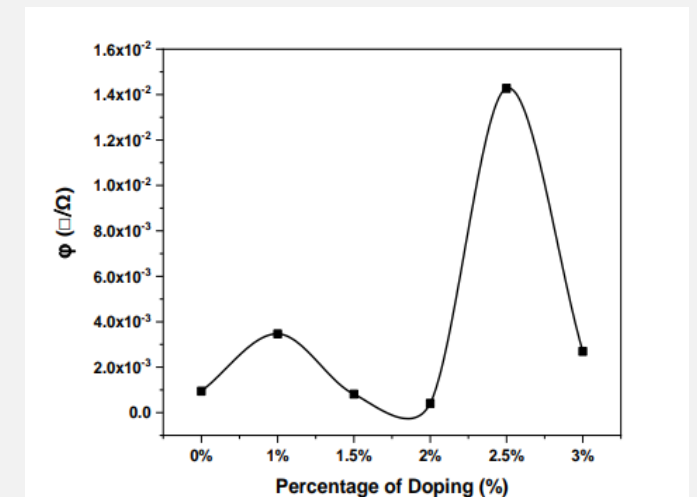


Fig. 4: Draw of R_{sh} values of undoped and Ag 1-3 Ag/Sn % doped