

References

1. Zhou, Y. and Kelly, P. J. The properties of tin-doped indium oxide films prepared by pulsed magnetron sputtering from powder targets. *Thin Solid Films* **469–470** (2004): 18–23.
2. Chen, M., Pei, Z. L., Sun, C., Gong, J., Huang, R. F. and Wen, L. S. ZAO: an attractive potential substitute for ITO in flat display panels. *Materials Science and Engineering B* **85** (2001): 212–217.
3. Ellmer, K. Magnetron sputtering of transparent conductive zinc oxide: relation between the sputtering parameters and the electronic properties. *J. Phys. D: Appl. Phys.* **33** (2000): R17–R32.
4. Pearton, S. J., Norton, D. P., Ip, K., Heo, Y. W. and Steiner, T. Recent progress in processing and properties of ZnO. *Progress in Materials Science* **50** (2005): 293–340.
5. Tominaga, K., Manabe, H., Umezumi, N., Mori, I., Ushiro, T. and Nakabayashi, I. Film properties of ZnO:Al prepared by cosputtering of ZnO:Al and either Zn or Al targets. *J. Vac. Sci. Technol. A* **15** (3) (1997): 1074–1079.
6. Ramanathan, K., Teeter G., Keane, J. C. and Noufi, R. Properties of high-efficiency CuInGaSe₂ thin film solar cells. *Thin Solid Films* **480–481** (2005): 499–502.
7. Martín, A., Espinós, J. P., Justo, A., Holgado, J. P., Yubero, F. and González-Eliphe, A. R. Preparation of transparent and conductive Al-doped ZnO thin films by ECR plasma enhanced CVD. *Surface and Coatings Technology* **151–152** (2002): 289–293.
8. Jiménez-González, A. E., Soto Urueta, J. A. and Suárez-Parra, R. Optical and electrical characteristics of aluminum-doped ZnO thin films prepared by solgel technique. *J. Crystal Growth* **192** (1998): 430–438.
9. Seeber, W. T., Abou-Helal, M. O., Barth, S., Beil, D., Höche, T., Afify, H. H. and Demian, S. E. Transparent semiconducting ZnO:Al thin films prepared by spray pyrolysis. *Materials Science in Semiconductor Processing* **2** (1999): 45–55.

10. Kim, H., Horwitz, J. S., Qadri, S. B. and Chrisey, D. B. Epitaxial growth of Al-doped ZnO thin films grown by pulsed laser deposition. *Thin Solid Films* **420–421** (2002): 107–111.
11. Martínez, M. A., Herrero, J. and Gutiérrez, M. T. Properties of RF sputtered zinc oxide based thin films made from different targets. *Sol. Energy Mater. Sol. Cells.* **31** (1994): 489–498.
12. Cebulla, R., Wendt, R. and Ellmer, K. Al-doped zinc oxide films deposited by simultaneous rf and dc excitation of a magnetron plasma: Relationships between plasma parameters and structural and electrical film properties. *J. Appl. Phys.* **83** (2) (1998): 1087–1095.
13. Park, K. C., Ma, D. Y. and Kim, K. H. The physical properties of Al-doped zinc oxide films prepared by RF magnetron sputtering. *Thin Solid Films* **305** (1997): 201–209.
14. Song, D., Widenborg, P., Chin, W. and Aberle, A. G. Investigation of lateral parameter variations of Al-doped zinc oxide films prepared on glass substrates by rf magnetron sputtering. *Sol. Energy Mater. Sol. Cells.* **73** (2002): 1–20.
15. Brehme, S., Fenske, F., Fuhs, W., Nebauer, E., Poschenrieder, M., Selle, B. and Sieber, I. Free-carrier plasma resonance effects and electron transport in reactively sputtered degenerate ZnO:Al films. *Thin Solid Films* **342** (1999): 167–173.
16. Minami, T., Sato, H., Sonoda, T., Nanto, H. and Takata, S. Influence of substrate and target temperatures on properties of transparent and conductive doped ZnO thin films prepared by R.F. magnetron sputtering. *Thin Solid Films* **171** (1989): 307–311.
17. Ugsornrat, K. *Transparent Conducting ZnO(Al) Thin Films Deposited by Sequential RF and DC Magnetron Sputtering*. Master's Thesis, Chulalongkorn University, (2002).
18. Gao, W. and Li, Z. ZnO thin films produced by magnetron sputtering. *Ceramics International* **30** (2004): 1155–1159.

19. Ondo–Ndong, R., Ferblantier, G., Al Kalfioui, M., Boyer, A. and Foucaran, A. Properties of RF magnetron sputtered zinc oxide thin films. *J. Crystal Growth* **255** (2003): 130–135.
20. Uthanna, S., Subramanyam, T. K., Srinivasulu Naidu, B. and Mohan Rao, G. Structure–composition–property dependence in reactive magnetron sputtered ZnO thin films. *Optical Materials* **19** (2002): 461–469.
21. Igasaki, Y. and Kanma, H. Argon gas pressure dependence of the properties of transparent conducting ZnO:Al films deposited on glass substrates. *Appl. Surf. Sci.* **169–170** (2001): 508–511.
22. Ellmer, K., Cebulla, R. and Wendt, R. Transparent and conducting ZnO(:Al) films by simultaneous RF– and DC–excitation of a magnetron. *Thin Solid Films* **317** (1998): 413–416.
23. Jäger, S., Szyszka, B., Szczyrbowski, J. and Bräuer, G. Comparison of transparent conductive oxide thin films prepared by a.c. and d.c. reactive magnetron sputtering. *Surface and Coatings Technology* **98** (1998): 1304–1314.
24. Martínez, M. A., Herrero, J. and Gutiérrez, M. T. Deposition of transparent and conductive Al–doped ZnO thin films for photovoltaic solar cells. *Sol. Energy Mater. Sol. Cells.* **45** (1997): 75–86.
25. Minami, T., Yamamoto, T. and Miyata, T. Highly transparent and conductive rare earth–doped ZnO thin films prepared by magnetron sputtering. *Thin Solid Films* **366** (2000): 63–68.
26. Chapman, B. *Glow Discharge Processes: Sputtering and Plasma Etching*. New York: John Wiley & Son, 1980.
27. Ohring, M. *The Materials Science of Thin Films*. San Diego: Academic Press, 1992.
28. Van der Pauw, L. J. A method of measuring the resistivity and hall coefficient on lamellae of arbitrary shape. *Phil. Tech. Rev.* **20** (1958): 220–224.
29. Schroder, D. K. *Semiconductor Material and Device Characterization*. Singapore: John Wiley & Son, 1990.
30. Huibers, P. D. T. and Shah, D. O. Multispectral determination of soap film thickness. *Langmuir* **13** (1997): 5995–5998.

31. Sze, S. M. *Semiconductor Devices: Physics and Technology*. New Jersey: John Wiley & Son, 1985.
32. Pankove, J. I. *Optical Processes in Semiconductors*. New York: Dover Publications, 1971.
33. Cullity, B. D. *Elements of X-Ray Diffraction*. Massachusetts: Addison-Wesley Publishing Company, 1956.
34. Wongmaneerod, S. *Computerized System for Measuring Resistivity and Hall Mobility*. Master's Thesis, Chulalongkorn University, (1995).
35. Haug, F. -J., Geller, Zs., Zogg, H., Vignali, C. and Tiwari, A. N. Influence of deposition conditions on the thermal stability of ZnO:Al films grown by rf magnetron sputtering. *J. Vac. Sci. Technol. A* **19**(1) (2001): 171-174.
36. Zhang, D. H., Ma, H. L. Scattering mechanisms of charge carriers in transparent conducting oxide films. *Appl. Phys. A* **62** (1996): 487-492.
37. Lee, J. C., Kang, K. H., Kim, S. K., Yoon, K. H., Park, I. J. and Song, J. RF sputter deposition of the high-quality intrinsic and n-type ZnO window layers for Cu(In,Ga)Se₂-based solar cell applications. *Sol. Energy Mater. Sol. Cells*. **64** (2000): 185-195.

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- 2004 Montri Aiempanakit, Chanwit Chityuttakan, Sojiphong Chatrathorn and Kajornyod Yoodee, "The Properties of Aluminum-Doped Zinc Oxide Thin Films Prepared by RF Magnetron Sputtering from an Embedded-Zinc ZnO(Al) Target", *30th Congress on Science and Technology of Thailand (STT 2004)*, Impact Exhibition and Convention Center, Muang Thong Thani, Bangkok, Thailand, October 19-21, (2004).

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