UNIVERSITÄT LEIPZIG

BuildMoNa

SCIENTIFIC AND METHOD MODULES

Module name	Transparent Conductive Oxides – Fundamentals and Applications
Number	2019-A3
Aims	The material class of transparent conductive materials has been discovered 1907 by Karl W. Bädeker in Leipzig. This module focuses on modern transparent functional materials, from fabrication through material physics to applications.
Basics	covered in basic modules B1–B3, solid state physics, wide gap materials
Contents	The fundamental solid state aspects include defect formation in such materials, the electronic band structure theory (LDA is not a good approximation for such metal oxides) and p-type doping (which is notoriously difficult for many oxides). Research on bulk properties has been promoted by the availability of substrates and/or bulk crystals for a number of oxides (ZnO for a while, recently Ga_2O_3). From an application point of view, materials with larger mobility (at high carrier concentration), materials from earth abundant materials (avoiding expensive and noble metals), materials suitable for low temperature fabrication (in order to reduce the energy budget of industrial processes, process compatibility with flexible electronics), and amorphous materials (for flexible electronics and also room temperature deposition) are desirable.
Methods	Thin film deposition, optical and electrical characterization, device processing, however module has no focus on methodological aspects.
Type	Two-day block course
Date (month/year)	23 to 27 September 2019 (two days, 3-5 days optional)
Time	exact schedule t.b.a.
Work load	15 hours presence/ 45 hours self-study
Examination	As module exam *either* a poster for the poster session is submitted and accepted by the program committee *or* one of the invited talks is summarized with a few references and the discussion after the presentation reproduced. Typical length of this work (in English) is 2 pages. The paper will be graded.
Credit points	2
Responsible scientists	Prof. M. Grundmann, Dr. Holger von Wenckstern
International guest lecturers	P. Barquinha, Univ. NOVA de Lisboa; L.J. Brillson, Ohio State Univ., Columbus, OH; V. Darakchieva, Linköping Univ.; R. Frisenda, IMDEA Nano Madrid; G. Iannaccone, Univ. of Pisa; M. Himmerlich, CERN, Geneva; H. Hosono, Tokyo Inst. of Technoloy; D. Jena, Cornell Univ., NY; G. Jessen, AirForce Res. Lab., Ohio; J. Kaczmarski, Institute of Electron Technology, Warsaw; G. Koster, Univ. of Twente; N. Münzenrieder, Univ. of Sussex; S. Rajan, Ohio State Univ. Columbus, OH; A. Schleife, Univ. of Illinois, Urbana-Champaign; J. Speck, UC Santa Barbara; C. Di Valentin, Univ. of Milan; Ch. Van de Walle, UC Santa Barbara; W. Walukiewicz, Lawrence Berkeley; A. Zakutayev, NREL, Golden, CO
Industrial partners	Malvern Panalytical
Recommendations for literature, e-learning	Transparent Electronics: From Synthesis to Applications, Editor: ANTONIO FACCHETTI and TOBIN J. MARKS, John Wiley & Sons Ltd, 2010; Handbook of Transparent Conductors, Editor: David S. Ginley, Hideo Hosono, David C. Paine, Springer Science and Business Media, 2010; Transparent Electronics, Autor: J.F. Wager, D.A. Keszler, R.E. Presley, Springer Verlag, 2008; Springer Series in Materials Science 104, Transparent Conductive Zinc Oxide, Basics and Applications in Thin Film Solar Cells, Editor: Klaus Ellmer, Andreas Klein, Bernd Rech, Springer Verlag 2008

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