

Optically Stimulated Luminescence Dosimetry

Lars Böttcher-Jensen | Stephen M.S. McKee | Ann G. Windle



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SJ Ball



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Optically Stimulated Luminescence Dosimetry L. Boetter-Jensen, S.W.S. McKeever, A.G. Wintle, 2003-10-24 Optically Stimulated Luminescence OSL has become the technique of choice for many areas of radiation dosimetry. The technique is finding widespread application in a variety of radiation dosimetry fields including personal monitoring, environmental monitoring, retrospective dosimetry including geological dating and accident dosimetry, space dosimetry and many more. In this book we have attempted to synthesize the major advances in the field covering both fundamental understanding and the many applications. The latter serve to demonstrate the success and popularity of OSL as a dosimetry method. The book is designed for researchers and radiation dosimetry practitioners alike. It delves into the detailed theory of the process from the point of view of stimulated relaxation phenomena, describing the energy storage and release processes phenomenologically and developing detailed mathematical descriptions to enable a quantitative understanding of the observed phenomena. The various stimulation modes, continuous wave, pulsed or linear modulation, are introduced and compared. The properties of the most important synthetic OSL materials, beginning with the dominant carbon-doped Al_2O_3 and moving through discussions of other less well studied but nevertheless important or potentially important materials. The OSL properties of the two most important natural OSL dosimetry material types, namely quartz and feldspars, are discussed in depth. The applications chapters deal with the use of OSL in personal, environmental, medical and UV dosimetry, geological dating and retrospective dosimetry, accident dosimetry and dating. Finally, the developments in instrumentation that have occurred over the past decade or more are described. The book will find use in those laboratories within academia, national institutes and the private sector where research and applications in radiation dosimetry using luminescence are being conducted. Potential readers include personnel involved in radiation protection practice and research, hospitals, nuclear power stations, radiation clean up and remediation, food irradiation and materials processing, security monitoring, geological and archaeological dating, luminescence studies of minerals etc.

An Introduction to Time-Resolved Optically Stimulated Luminescence Makaiko L Chithambo, 2018-12-18 Time-resolved optical stimulation of luminescence has become established as an important method for measurement of optically stimulated luminescence. Its enduring appeal is easy to see with the number of materials studied growing from the initial focus on natural minerals such as quartz and feldspar to synthetic dosimeters such as Al_2O_3 , $\text{C}:\text{BeO}$ and $\text{YAlO}_3:\text{Mn}^{2+}$. The aim of time-resolved optical stimulation is to separate in time the stimulation and emission of luminescence. The luminescence is stimulated from a sample using a brief light pulse. The ensuing luminescence can be monitored either during stimulation in the presence of scattered stimulating light or after the light pulse. The time-resolved luminescence spectrum measured in this way can be resolved into components each with a distinct lifetime. The lifetimes are linked to physical processes of luminescence and thus provide a means to study dynamics involving charge transfer between point defects in materials. This book is devoted to time-resolved optically stimulated luminescence and is suitable for

researchers with an interest in the study of point defects using luminescence methods The book first sets the method within the context of luminescence field at large and then provides an overview of the instrumentation used There is much attention on models for time resolved optically stimulated luminescence two of which are analytical and the third of which is based on computational simulation of experimental results To bring relevance to the discussion the book draws on examples from studies on quartz and a Al_2O_3 C two materials widely investigated using this method The book shows how kinetic analysis for various thermal effects such as thermal quenching and thermal assistance can be investigated using time resolved luminescence Although use of light sums is an obvious choice for this contemporary work is discussed to show the versatility of using other alternative methods such the dynamic throughput

Physics and Engineering of Radiation Detection Syed Naeem Ahmed, 2007-04-12 Physics and Engineering of Radiation Detection presents an overview of the physics of radiation detection and its applications It covers the origins and properties of different kinds of ionizing radiation their detection and measurement and the procedures used to protect people and the environment from their potentially harmful effects It details the experimental techniques and instrumentation used in different detection systems in a very practical way without sacrificing the physics content It provides useful formulae and explains methodologies to solve problems related to radiation measurements With abundance of worked out examples and end of chapter problems this book enables the reader to understand the underlying physical principles and their applications Detailed discussions on different detection media such as gases liquids liquefied gases semiconductors and scintillators make this book an excellent source of information for students as well as professionals working in related fields Chapters on statistics data analysis techniques software for data analysis and data acquisition systems provide the reader with necessary skills to design and build practical systems and perform data analysis Covers the modern techniques involved in detection and measurement of radiation and the underlying physical principles Illustrates theoretical and practical details with an abundance of practical worked out examples Provides practice problems at the end of each chapter

Radiation Detection and Measurement Glenn F. Knoll, 2010-08-16 Known for its comprehensive coverage and up to date literature citations this classic text provides students and instructors with the most complete coverage available of radiation detection and measurement Over the decade that has passed since the publication of the 3rd edition technical developments continue to enhance the instruments and techniques available for the detection and spectroscopy of ionizing radiation The Fourth Edition of this invaluable resource incorporates the latest developments and cutting edge technologies to make this the most up to date guide to the field available Covers many new materials that are emerging as scintillators that can achieve energy resolution that is better by a factor of two compared with traditional materials Presents new material on ROC curves micropattern gas detectors new sensors for scintillation light thick film semiconductors and digital techniques in detector pulse processing Includes updated discussions on TLDs neutron detectors cryogenic spectrometers radiation backgrounds and the VME instrumentation standard

Solid State

Dosimetry Francesco D'Errico, 2006

The Climate of Past Interglacials F. Sirocko, M. Claussen, T. Litt, M.F.

Sanchez-Goni, 2006-12-08 Historically climate fluctuations such as the Little Ice Age show that interglacial climate change is not entirely stable but responds to even subtle changes in radiative forcing. Through research it has been made clear that even an abrupt change of climate within years is not just a theoretical possibility but has in fact happened in the prehistoric past. It is therefore clear that in principle it could happen again. Human civilization has exploded under the mild and relatively stable climatic conditions that have prevailed over the last 11 000 years. This book focuses on revisiting the past and to study climate and environment in a suite of experiments where boundary conditions are similar but not identical to today so we can learn about the climate environment system its sensitivity thresholds and feedback. The palaeoclimate community holds an important key to scientific information on climate change that provides a basis for appropriate adaptation and mitigation strategies. The authors of this book have taken up this challenge and summarize their results in this special volume. It presents state of the art science on new reconstructions from all spheres of the Earth System and on their synthesis on methodological advances and on the current ability of numerical models to simulate low and high frequency changes of climate environment and chemical cycling related to interglacials. Summarizes important information on climate change providing a basis for appropriate adaptation and mitigation strategies for human civilization. Reports on new reconstructions on methodological advances numerical models simulating low and high frequency changes and chemical cycling related to interglacials. Incorporates palaeovegetation and numerical modeling of climate and environmental and geochemical parameters to address regional feedback to global change with successful data models. Optically Stimulated

Luminescence Eduardo G. Yukihara, Stephen W. S. McKeever, 2011-02-16 Optically stimulated luminescence has developed into one of the leading optical techniques for the measurement and detection of ionizing radiation. This text covers in a readable manner advanced modern applications of the technique how it can play a useful role in different areas of dosimetry and how to approach the challenges presented when working with optically stimulated luminescence. The six chapters are as follows: Introduction including a short history of OSL and details of successful applications; Theory and Practical Aspects; Personal Dosimetry; Space Dosimetry; Medical Dosimetry; Other Applications and Concepts including retrospective and accident dosimetry; environmental monitoring and UV dosimetry. Throughout the book the underlying theory is discussed on an as needed basis for a complete understanding of the phenomena but with an emphasis of the practical applications of the technique. The authors also give background information and relevant key references on each method inviting the reader to explore deeper into the subject independently. Postgraduate researchers and those involved with radiation dosimetry will find this book particularly useful. The material is both relevant and accessible for both specialists and those new to the field therefore is fundamental to any academic interested in modern advances of the subject. **Development of Optically**

Stimulated Luminescence Techniques Using Natural Minerals and Ceramics, and Their Application to

Retrospective Dosimetry Lars Bøtter-Jensen, 2000

Luminescence Chithambo Makaiko L, 2018

Introduction to Time-Resolved Optically Stimulated

Thermally and Optically Stimulated Luminescence Reuven Chen, Vasilis

Pagonis, 2011-04-08 Thermoluminescence TL and optically stimulated luminescence OSL are two of the most important techniques used in radiation dosimetry They have extensive practical applications in the monitoring of personnel radiation exposure in medical dosimetry environmental dosimetry spacecraft nuclear reactors food irradiation etc and in geological archaeological dating Thermally and Optically Stimulated Luminescence A Simulation Approach describes these phenomena the relevant theoretical models and their prediction using both approximations and numerical simulation The authors concentrate on an alternative approach in which they simulate various experimental situations by numerically solving the relevant coupled differential equations for chosen sets of parameters Opening with a historical overview and background theory other chapters cover experimental measurements dose dependence dating procedures trapping parameters applications radiophotoluminescence and effects of ionization density Designed for practitioners researchers and graduate students in the field of radiation dosimetry Thermally and Optically Stimulated Luminescence provides an essential synthesis of the major developments in modeling and numerical simulations of thermally and optically stimulated processes

Characterization of a Commercial Optically Stimulated Luminescence Dosimetry System Bryan Remley, 2017 There is a need to better understand the risks of low level radiation dose in medical diagnostic procedures and ensure that dose measurements are accurate and traceable to National Standards Users of instruments typically calibrate their dosimeters with one type of radiation beam with a specific photon energy spectrum referred to as beam quality and then may use these dosimeters to measure radiation in other types of radiation beam qualities over a different range of photon energies This is not a problem if the dosimeter response is relatively constant for a broad range of photon energies However the response of the optically stimulated luminescent OSL dosimeters studied in this work have a relatively strong energy dependence for photons with energies less than 100 keV Moreover since this work focused on measuring doses in diagnostic units only where the mean photon energies are below 100 keV using a single calibration based on an 80 kVp beam quality as provided by the vendor of the system could result in inaccurate dose measurements To address this hypothesis as part of this work the system was calibrated independently using other beam qualities that better match those of diagnostic units including RQR50 RQR60 M60 M80 and M100 Lamperti O'Brien 2001 available at the National Institute of Standards and Technology NIST A comparison was then made of the air kerma measured by the OSL system using both the vendor's OSL reader calibration and the independent calibration implemented in this work This comparison shows that when measuring air kerma in x ray beams with beam qualities that have energy spectra different than the energy spectra of the x ray beam in which the vendor prepared their calibration set 80 kVp x ray beam significant differences of up to 20% are observed Because of this comparison a set of beam quality correction factors BQCF were developed that allows correcting the air kerma values

measured with the vendor's calibrated OSL system to account for the differences in energy spectra in the air kerma measurement for different beam qualities and ensuring traceability to the national standard for air kerma

A Course in Luminescence Measurements and Analyses for Radiation Dosimetry Stephen W. S. McKeever, 2022-05-16 A Course in Luminescence Measurements and Analyses for Radiation Dosimetry A complete approach to the three key techniques in luminescence dosimetry In A Course in Luminescence Measurements and Analyses for Radiation Dosimetry expert researcher Stephen McKeever delivers a holistic and comprehensive exploration of the three main luminescence techniques used in radiation dosimetry thermoluminescence optically stimulated luminescence and radiophotoluminescence The author demonstrates how the three techniques are related to one another and how they compare to each other Throughout the author's focus is on pedagogy including state of the art research only where it is relevant to demonstrate a key principle or where it reveals a critical insight into physical mechanisms The primary purpose of the book is to teach beginning researchers about the three aforementioned techniques their similarities and distinctions and their applications A Course in Luminescence Measurements and Analyses for Radiation Dosimetry offers access to a companion website that includes original data sets and problems to be solved by the reader The book also includes A thorough introduction to the field of luminescence applications in radiation dosimetry including a history of the subject Comprehensive explorations of introductory models and kinetics including the concepts of thermoluminescence optically stimulated luminescence and radiophotoluminescence Practical discussions of luminescence curve shapes including the determination of trapping parameters from experimental thermoluminescence and optically stimulated luminescence data In depth examinations of dose response functions superlinearity supralinearity and sublinearity as well as the causes of non linearity Detailed examples with well known materials A Course in Luminescence Measurements and Analyses for Radiation Dosimetry is an invaluable guide for undergraduate and graduate students in the field of radiation dosimetry as well as faculty and professionals in the field

Advances In Physics And Applications Of Optically And Thermally Stimulated Luminescence Reuven Chen, Vasilis Pagonis, 2019-03-06 In this volume international leading experts in the study of thermally and optically stimulated luminescence give an up to date comprehensive coverage of the theoretical and experimental aspects of these subjects as well as their applications The theory of thermoluminescence TL and optically stimulated luminescence OSL are discussed in detail including mainly solid state models of localized and delocalized transitions These models cover the effects occurring during the excitation by irradiation and the read out by heating or by exposure to light The methods described consist of analytical mathematical considerations as well as numerical simulations The main application of these effects namely radiation dosimetry includes personal and environmental dosimetry as well as retrospective dosimetry and the dosimetry of cosmic radiation and space missions Also discussed in detail are archaeological and geological dating the use of luminescence dosimetry in medical physics as well as general applications in geosciences other model subjects such as time

resolved luminescence and thermally assisted OSL and the sister subject of thermoluminescence in photosynthetic materials

Dosimetry Based on Thermally and Optically Stimulated Luminescence, Dissertation Submitted June 1997 for the Ph.D.Degree at the Niels Bohr Institute, University of Copenhagen Niels Agersnap Larsen,Forsogsanlag Riso,Københavns universitet,1999 Methodological Developments for Application of Optically Stimulated Luminescence (OSL) in Medical Dosimetry Patricia Beringhs Rio Gasparian,2009 Optically Stimulated Luminescence Dosimetry with NaCl Pellets Lovisa Waldner,2021 **Protocols for Thermoluminescence and Optically Stimulated Luminescence Research at DOSAR.**

SM. Bernal,2004 The Life Sciences Division LSD of Oak Ridge National Laboratory ORNL has a long record of radiation dosimetry research at the Dosimetry Applications Research DOSAR facility complex These facilities have been used by a broad segment of the research community to perform a variety of experiments in areas including but not limited to radiobiology radiation dosimeter and instrumentation development and calibration and materials testing in a variety of radiation environments Collaborations with the University of Tennessee Knoxville UTK have also led to important contributions in the area of archaeometry particularly as it relates to the use of radiation dosimetry to date archaeological artifacts This manual is to serve as the primary instruction and operation manual for dosimetric and archaeometric research at DOSAR involving thermoluminescence TL and optically stimulated luminescence OSL Its purpose is to 1 provide protocols for common practices associated with the research 2 outline the relevant organizational structure 3 identify the Quality Assurance plan and 4 describe all the procedures operations and responsibilities for safe and proper operation of associated equipment Each person who performs research at DOSAR using TL OSL equipment is required to read the latest revision of this manual and be familiar with its contents and to sign and date the manual s master copy indicating that the manual has been read and understood The TL OSL Experimenter is also required to sign the manual after each revision to signify that the changes are understood Each individual is responsible for completely understanding the proper operation of the TL OSL equipment used and for following the guidance contained within this manual The instructions protocols and operating procedures in this manual do not replace supersede or alter the hazard mitigation controls identified in the Research Safety Summary Thermoluminescence Optically Stimulated Luminescence Dosimetry for this research ORNL s Standards Based Management System or any other official guidelines

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