

OPTICALLY STIMULATED LUMINESCENCE(OSL) DOSIMETRY IN RADIOTHERAPY

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Medical physics section

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Optically Stimulated Luminescence Dosimetry

Offormata Emmanuel Osunkwor



Optically Stimulated Luminescence Dosimetry:

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. Optically Stimulated Luminescence Eduardo G. Yuhikara, 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.

Postgraduates 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

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

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

Development of an Instrument for Spatially Resolved, Optically Stimulated Luminescence Dosimetry of Cobble and Dosimeter Surfaces Christopher Garcia, 2023 Optically stimulated luminescence OSL dosimetry is a method used to determine the amount of energy stored within a crystalline insulator due to ionizing radiation At its most fundamental OSL dosimetry requires optical stimulation to induce a sample to emit luminescence a light detection apparatus to collect the luminescence signal and a calibrating radiation source to convert the acquired signal into an equivalent dose Conventional instruments have successfully integrated these components to perform OSL dosimetry on sediment and dosimeters In this dissertation an instrument was developed that improves upon commercially available instruments by providing spatial information that allows dose mapping The novel instrument LuCIDD Luminescence instrument with Confocal and Imaging unit for Dating and Dosimetry is based on the principles of a confocal microscope This dissertation outlines the requirements for spatially resolved dosimetry mapping and describes the design and construction of LuCIDD Tests of LuCIDD s lasers ability to perform spatially resolved stimulating measurements were made by measuring their focal spot size power density and penetration depth Used for calibration the built in X ray source s energy spectrum uniformity and dose rate were characterized The minimum resolution and stimulation time of measurements were determined quantifying the amount of time to complete a dose map of a sample s surface Lastly LuCIDD s ability to recover a known applied dose from single points was verified to provide a proof of concept for future dose mapping measurements **A Course in Luminescence**

Measurements and Analyses for Radiation Dosimetry Stephen W. S. McKeever, 2022-05-25 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 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

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

Questions And Answers On Thermoluminescence (TL) And Optically Stimulated Luminescence (OSL) Claudio Furetta, 2008-11-25 Currently thermoluminescence TL and optically stimulated luminescence OSL are the main techniques for studying the luminescence properties of several materials mainly insulators called phosphors Frequently however students and experts alike need to clarify some concepts related to the effects and defects present in the radiation interaction with solids generated by these phenomena In this book a series of questions and corresponding answers give a clearer explanation about the concepts theory and models related to TL and OSL including applications in important related areas Students researchers and teachers will find this book a good guide for understanding TL and OSL as methods for studying the nature of luminescent solids It provides a quick way for clearing doubts in the concepts and terminology concerning OSL and TL as it is intended to answer many questions which can be encountered in practical applications **Radiation**

Therapy Dosimetry Arash Darafsheh, 2021-03-08 This comprehensive book covers the everyday use and underlying principles of radiation dosimeters used in radiation oncology clinics It provides an up to date reference spanning the full range of current modalities with emphasis on practical know how The main audience is medical physicists radiation oncology physics residents and medical physics graduate students The reader gains the necessary tools for determining which detector is best for a given application Dosimetry of cutting edge techniques from radiosurgery to MRI guided systems to small fields and proton therapy are all addressed Main topics include fundamentals of radiation dosimeters brachytherapy and external beam radiation therapy dosimetry and dosimetry of imaging modalities Comprised of 30 chapters authored by leading experts in the medical physics community the book Covers the basic principles and practical use of radiation dosimeters in radiation oncology clinics across the full range of current modalities Focuses on providing practical guidance for those using these detectors in the clinic Explains which detector is more suitable for a particular application Discusses the state of the art in radiotherapy approaches from radiosurgery and MR guided systems to advanced range verification techniques in proton therapy Gives critical comparisons of dosimeters for photon electron and proton therapies [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 C BeO and YAlO_3 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 Al_2O_3 . 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 as the dynamic throughput.

Emerging Trends in Synthesis and Catalysis in Chemistry Sunita Rattan, Bhuvanesh Gupta, Christine Jeyaseelan, Anita Gupta, 2024-09-23. This book presents the select papers from the International Symposium on Emerging Trends in Synthesis and Catalysis (ETSC) 2023. It covers the latest trends in novel synthesis strategies and highly efficient heterogeneous homogeneous catalytic chemical species. Various topics covered in this book are green synthesis reaction designs catalyst synthesis advanced materials for organic synthesis polymer synthesis stereoselective synthesis flow chemistry bio catalysis organo catalysis catalysis for sustainable development and industrial processes multiphase catalysis separation science and process development organometallic compounds in synthesis and catalysis computational tools for synthetic processes and processes for environment sustainability. The book is useful for researchers academicians and industrialists working in material science and industrial chemistry.

Borate Phosphors S. K. Omanwar, R. P. Sonekar, N. S. Bajaj, 2022-05-11. Borate based phosphors have attracted much attention due to their high optical stability low cost synthesis via conventional and non conventional methods and resulting technology to be environmentally friendly. This book discusses the structural and chemical parameters of borates as a phosphor including suitable synthesis methods and proper characterization of materials. Further it includes applications of borate materials such as photoluminescence UV application UVU application photo therapy application and radiological applications. Features: Provides information on borate phosphors and their structure. Aids selection of proper structural and functional borates used in applications based on phosphor technology. Discloses the modification in properties of borate functional group upon mixing or substitution with other metallic functional groups. Discusses biological applications such as photo thermal heating based therapy temperature sensors.

imaging and diagnosis Includes current trends and innovations limitations and challenges prospects and scope in each chapter This book is aimed at researchers and graduate students in inorganic materials luminescent optical materials materials science engineering and physics

Commissioning of an Optically Stimulated Luminescence Dosimetry (OSLD) System for in Vivo Dosimetry Offormata Emmanuel Osunkwor, 2018 A commercial OSL dosimetry system was investigated for passive in vivo dosimetry in radiation therapy Al₂O₃ C OSLDs have been characterized by various authors and researchers however an AAPM protocol for its clinical use is still in progress In this work a system of nanoDots with the microStar reader Landauer Inc was tested using typical radiotherapy beams in our clinic The goal was to fully characterize the system and determine all the necessary correction factors for accurate patient dose measurements The results demonstrate that our OSLD system is a valid alternative to already established in vivo dosimetry methods in our clinic

Optically Stimulated Luminescence (OSL) Dating in the Amazonian Wetlands Sonia Hatsue Tatumi, Dilce de Fátima Rossetti, Emílio Alberto Amaral Soares, 2020-07-09 Optically stimulated luminescence OSL dating has proven to be extremely useful for establishing the Late Quaternary chronological framework in many areas of the Brazilian territory In this region dominated by tropical climate OSL dating can be more extensively applied than radiocarbon dating due to the generally low potential for the preservation of organic matter in sedimentary samples This problem is especially critical in areas of the Amazonian lowlands because of the hot climate and high precipitation rates The abundance of quartz grains deposited in fluvial and aeolian environments over this region favours OSL dating More than 20 years of continuous and collaborative work has resulted in the creation of an extensive OSL age database for Late Quaternary sedimentary deposits in the Amazonian lowlands This effort has contributed to improving the paleoenvironmental and paleoclimatic reconstructions of this region within this period This book discusses the state of art of OSL dating of Late Quaternary deposits in the Amazonian lowlands focusing on providing an introduction to dating principles using OSL and defining the application of OSL techniques as a dating method It also offers a statistical study and calculation of equivalent dose and annual dose rates details the sampling and experimental apparatus and considers the difficulties and adaptation techniques in dating Late Quaternary strata in the Amazonian lowlands

Radiation Dosimetry Phosphors Sanjay J. Dhoble, Vibha Chopra, Vinit Nayar, George Kitis, Dirk Poelman, Hendrik C. Swart, 2022-05-26 Radiation Dosimetry Phosphors provides an overview of the synthesis properties and applications of materials used for radiation dosimetry and reviews the most appropriate phosphor materials for each radiation dosimetry technique The book describes the available phosphors used commercially for their applications in the medical field for dose measurements Although radiation dosimetry phosphors are commercially available continuous efforts have been made by the worldwide research community to develop new materials or improve already existing materials used in different areas with low or high levels of radiation Moreover researchers are still working on developing dosimetric phosphors for OSL ML LL and RPL dosimetry This book provides an overall view of the phosphors available low

cost synthesis methods mechanisms involved emerging trends and new challenges for the development of emerging materials for radiation dosimetry It is suitable for those working in academia and R D laboratories in the discipline of materials science and engineering along with practitioners working in radiation and dosimetry Provides the fundamental concepts historical context and review of current phosphors available for radiation dosimetry Reviews low cost material methods to synthesize and characterize rare earth doped inorganic phosphors for different kinds of radiation dosimetry techniques Discusses key barriers and potential solutions for enabling commercial realization phosphors for radiation dosimetry applications

Luminescent Ceramics Morteza Sasani Ghamsari, Hyung-Ho Park, 2024-12-01 Luminescent Ceramics Fundamentals Properties Processing and Applications provides a detailed review of luminescent ceramic materials for lighting dosimetry and security The book s chapters cover oxide nitride and fluoride phosphors garnet transparent ceramics oxynitride and BeO ceramics doped MgAl_2O_4 ceramics for dosimetry and novel thermo luminescent ceramics for light emitting devices and security applications The book provides a comprehensive overview of the unique possibilities offered by ceramic materials in the field of light emission and applications It will be an essential reference resource for all researchers working in the area of luminescent materials Provides an extensive overview of recent research progress on luminescent ceramic materials and their application in lighting display dosimetry and ceramic lasers Covers fundamentals synthesis characterization properties production processing and applications Gives a list of requirements for the materials used for each energy technology Presents an evaluation and comparison of the choice of materials available including structure properties performance Identifies gaps potential for improvement in the field of luminescent ceramics [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 *World Congress on Medical Physics and Biomedical Engineering 2018* Lenka Lhotska, Lucie Sukupova, Igor Lacković, Geoffrey S. Ibbott, 2018-05-29 This book vol 3 presents the proceedings of the IUPESM World Congress on Biomedical Engineering and Medical Physics a triennially organized joint meeting of medical physicists biomedical engineers and adjoining health care professionals Besides the purely scientific and technological topics the 2018 Congress will also focus on other aspects of professional involvement in health care such as education and training accreditation and certification health technology assessment and patient safety The IUPESM meeting is an important forum for medical physicists and biomedical engineers in medicine and healthcare learn and share knowledge and discuss the latest research outcomes and technological advancements as well as new ideas in both medical physics and biomedical engineering field **Methodological Developments for Application of Optically Stimulated Luminescence (OSL) in Medical Dosimetry** Patricia Beringhs Rio Gasparian, 2009

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