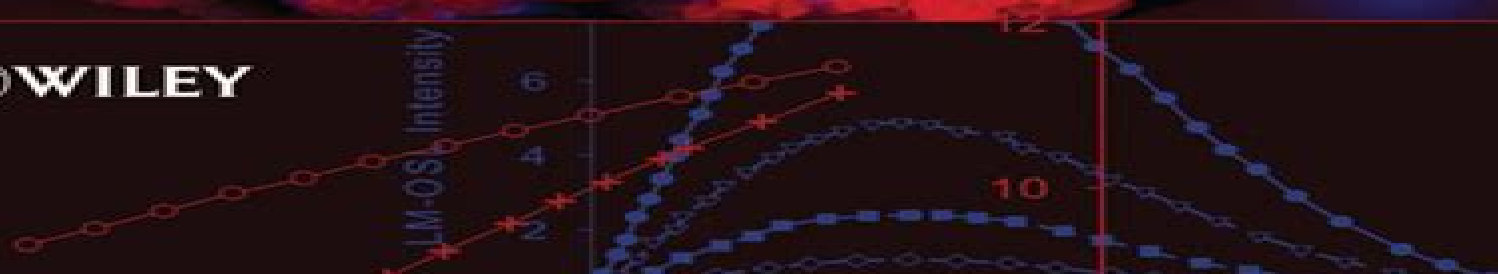


# Thermally and Optically Stimulated **Luminescence**

A Simulation Approach

Reuven Chen and Vasilis Pagonis

 **WILEY**



# Thermally And Optically Stimulated Luminescence A Simulation Approach

**Michael Aide, Takahito Nakajima**



## **Thermally And Optically Stimulated Luminescence A Simulation Approach:**

*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.

*Luminescence* Jagannathan Thirumalai, 2016-11-10 The aim of this book is to give readers a broad review of topical worldwide advancements in theoretical and experimental facts, instrumentation, and practical applications. It is erudite by luminescent materials and their prospects in dealing with different types of luminescence like photoluminescence, electroluminescence, thermo luminescence, triboluminescence, bioluminescence, design, and applications. The additional part of this book deals with the dynamics of rare earth ions, photon down up converting materials, luminescence dating, lifetime, bioluminescence, microscopical perspectives, and prospects towards the basic research or for more advanced applications. This book is divided into four main sections: luminescent materials and their associated phenomena, photo physical properties and their emerging applications, thermoluminescence dating from theory to applications, and bioluminescence perspectives and prospects. Individual chapters should serve the broad spectrum of common readers of diverse expertise: layman, students, and researchers who may in this book find easily elucidated fundamentals as well as progressive principles of specific subjects associated with these phenomena. This book was created by 14 contributions from experts in different fields of luminescence and technology from over 20 research institutes worldwide.

*Ionising Radiation and Mankind* D.V. Gopinath, N. Ramamoorthy, 2020-08-19 This book provides a comprehensive account of the developments and current status in several fields of the application of radioactivity and ionising radiation. It covers such topics as radiation based techniques, radiation's applications in medicine, food, and agriculture, its impact on industry, and its associated materials. The book will be of interest to a wide variety of readers including professionals in radiation medicine, industrial processes, food preservation, and agriculture.

*Rare Earth Elements and Their Minerals* Michael Aude, Takahito Nakajima, 2020-06-17 This book describes the recent evolution of rare earth

elements and their mineralogy both natural and synthetic analogues Authors review and document rare earth element chemistry in the aqueous environment and the petrology of the rare earth element bearing mineral Allanite Synthetic rare earth minerals and their applications is a rapidly evolving discipline important to medicine advanced digital technologies and solid state physics Authors report on the synthesis of a macrocyclic gadolinium complex and also gadolinium complexes and their applications in medicine Authors present compelling advances in gadolinium isotopes and oxides as substrates for induced excitation and luminescent material sciences

**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

**Luminescence Signal Analysis Using Python** Vasilis Pagonis,2022-03-31 This book compiles and presents a complete package of open access Python software code for luminescence signal analysis in the areas of radiation dosimetry luminescence dosimetry and luminescence dating Featuring more than 90 detailed worked examples of Python code fully integrated into the text 16 chapters summarize the theory and equations behind the subject matter while presenting the practical Python codes used to analyze experimental data and extract the various parameters that mathematically describe the luminescence signals Several examples are provided of how researchers can use and modify the available codes for different practical situations Types of luminescence signals analyzed in the book are thermoluminescence TL isothermal luminescence ITL optically stimulated luminescence OSL infrared stimulated luminescence IRSL timeresolved luminescence TR and dose response of dosimetric materials The open access Python codes are available at GitHub The book is well suited to the broader scientific audience using the tools of luminescence dosimetry physicists geologists archaeologists solid state physicists medical physicists and all scientists using luminescence dosimetry in their research The

detailed code provided allows both students and researchers to be trained quickly and efficiently on the practical aspects of their work while also providing an overview of the theory behind the analytical equations

**Luminescence** Vasilis Pagonis, 2021-05-11 This book covers applications of R to the general discipline of radiation dosimetry and to the specific areas of luminescence dosimetry luminescence dating and radiation protection dosimetry It features more than 90 detailed worked examples of R code fully integrated into the text with extensive annotations The book shows how researchers can use available R packages to analyze their experimental data and how to extract the various parameters describing mathematically the luminescence signals In each chapter the theory behind the subject is summarized and references are given from the literature so that researchers can look up the details of the theory and the relevant experiments Several chapters are dedicated to Monte Carlo methods which are used to simulate the luminescence processes during the irradiation heating and optical stimulation of solids for a wide variety of materials This book will be useful to those who use the tools of luminescence dosimetry including physicists geologists archaeologists and for all researchers who use radiation in their research

**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

*Unraveling Thermoluminescence* C M Sunta, 2014-07-15 The book is essentially about the theoretical aspects of thermoluminescence TL It is structured and written in a manner which will specially be of interest to the fresh undergraduate students and young researchers planning to take up work in the field of thermoluminescence It is arranged into seven chapters starting with the historical growth of the subject of TL and an overview of the luminescence phenomena A Physical model involving thermally disconnected deep traps is specially described Using this model expressions are derived for the TL intensity growth curve the supralinearity factor and the pre dose sensitization factor A new factor called the sensitization factor is introduced which co relates the supralinearity and the pre dose sensitization factors Dealing with the theoretical models of TL limitations of the general order GO kinetics and the mixed order kinetics models are specially

brought out Due to the lacunae of GO model the determination of activation energy becomes subject to error when GO model is applied to the experimental TL glow curves Satisfying the quasi equilibrium QE condition is essential for the validity of analytical models of TL A new method is given to ascertain if QE condition is satisfied in an experimental glow curve The book assumes a basic knowledge of physics and mathematics at an undergraduate level and takes the reader to the results at the cutting edge of understanding of the subject in an easy to understand manner

**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  $\text{Al}_2\text{O}_3$  C BeO and  $\text{YAlO}_3$  Mn<sup>2+</sup> 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  $\text{Al}_2\text{O}_3$  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

**Taking travel home** Emma Gleadhill, 2022-04-26 In the late eighteenth century elite British women had an unprecedented opportunity to travel Taking travel home uncovers the souvenir culture these women developed around the texts and objects they brought back with them to realise their ambitions in the arenas of connoisseurship friendship and science Key characters include forty three year old Hester Piozzi Thrale who honeymooned in Italy thirty one year old Anna Miller who accompanied her husband on a Grand Tour Dorothy Richardson who undertook various tours of England from the ages of twelve to fifty two and the sisters Katherine and Martha Wilmot who travelled to Russia in their late twenties The supreme tourist of the book the political salon hostess Lady Elizabeth Holland travelled to many countries with her husband including Paris where she met Napoleon and Spain during the Peninsular War Using a methodology informed by literary and design theory art history

material culture studies and tourism studies the book examines a wide range of objects from painted fans of the ruins of Rome for a sequin apiece and the Pope's blessed beads to lava from Vesuvius and pieces of Stonehenge. It argues that the rise of the souvenir is representative of female agency as women used their souvenirs to form spaces in which they could create and control their own travel narratives.

*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.

**Emerging Synthesis Techniques for Luminescent Materials** Tiwari, Ratnesh, Dubey, Vikas, Dhoble, Sanjay J., 2018-05-19

The design and study of materials is a pivotal component to new discoveries in the various fields of science and technology. By better understanding the components and structures of materials, researchers can increase their applications across different industries. *Emerging Synthesis Techniques for Luminescent Materials* is a critical scholarly resource that explores the important field of emerging synthesis techniques of luminescent materials and its practical applications. Featuring coverage on a broad range of topics such as electroluminescence, glow curve analysis, and upconversion, this book is geared towards engineers, academics, researchers, students, professionals, and practitioners seeking current research on photoluminescence and the study of rare earth-doped phosphors.

*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

*Persistently Luminescent Materials* Yuanbing Mao, 2025-06-24 A broad view of the booming field in optical materials based on their applications and potentials Persistent luminescence refers to a property of materials in which they retain luminescence for hours or even days without a source of excitation once being charged Persistently luminescent materials have found a huge range of technological applications from optical displays to chemical sensing to information storage and security technologies This growing field of research and development has never been such an important area of materials science *Persistently Luminescent Materials* offers a comprehensive overview of these emerging optical materials and their applications It presents all major research trends new information and novel properties of the major and developing persistently luminescent materials With detailed information on how to design new materials and create new functionalities it is a must for researchers and technologists in virtually every major area of industry *Persistently Luminescent Materials* readers will also find Practical applications in phototherapy biological imaging displays and more Detailed discussion of topics including sustainability techniques temperature sensing sterilization and optical information storage Analysis of how to use persistently luminescent materials to create new theranostic functionalities *Persistently Luminescent Materials* is ideal for specialists and professionals in the field but also for a broader readership seeking a perspective of practical needs related to the applications of optical and particularly persistently luminescent materials

**Time and Stone: The Emergence and Development of Megaliths and Megalithic Societies in Europe** Bettina Schulz Paulsson, 2017-09-15 This analysis is concerned with the dating of megaliths in Europe and is based on 2410 available radiocarbon results and the application of a Bayesian statistical framework It is so far the largest existing attempt to establish a supra regional synthesis on the emergence and development of megaliths in Europe

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

Trapped charge dating and its application in geomorphological, geological and archaeological studies in east asia Hui Zhao,Bo Li,Yuxin Fan,Hao Long,2023-02-17

**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 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

**The Analysis of Thermally Stimulated Processes** R. Chen,Y. Kirsh,2013-10-22 Thermally stimulated processes include a number of phenomena either physical or chemical in nature in which a certain property of a substance is measured during controlled heating from a low temperature Workers and graduate students in a wide spectrum of fields require an introduction to methods of extracting information from such measurements This book gives an interdisciplinary approach to various methods which may be applied to analytical chemistry including radiation dosimetry and determination of archaeological and geological ages In addition recent advances are included such as ionic thermocurrent of general order kinetics polarization thermocurrents and some aspects of the superlinear dependence on the dose of thermoluminescence

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