# Cellular level damage response



# Early tissue damage reaction



# Late tissue damage reaction



### Cardiovascular diseases





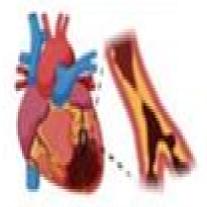
- Oxidative stress
- Epigenetic changes
- Increased expression of inflammatory cytokines and adherssion molecules
- Mitochondrial dysfunction
- Senescence
- Cell death



- Inflammatory cells adhere and transmigrate into subendothelial space
- Epithelium dysfunctional and permeability/leaky
- Bystander damage in vivo
- Cell compactment disorder
- Metabolic homeostasis disorder
- Microthrombosis



- Inflammation
- Vascular aging
- Capillary network loss
- Lipid-loaded foam cell formation
- Atherosclerotic plaque
- Stenosis/vessel narrow
- Fibrosis



Life Span Study of aomic bomb survivors (Shimizu, et al, 2010)

- (1) ~60% radiation-related excess non-cancer deaths are from circulatory diseases;
- (2) ERR/Gy for RICVD overall is 0.14 (95% CI 6 to 23%), for ischaemic heart diseases is 0.02 (95% CI -0.10 to 0.15);
- (3) <u>ICRP</u>: The best estimate of the dose-effect threshold is 0 Gy (i.e. no threshold, 95% CI <0 to 0.5 Gy) for heartt diseases, whereas it is 0.5 Gy for cerebrovascular.

# **Radiation Induced Changes In Microstruct**

**M Woodhall** 

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Radiation-induced Changes in Microstructure F. A. Garner, 1987 Radiation Induced Changes in Microstructure ,1987 Energy Research Abstracts ,1990 Effects of Radiation on Materials Roger E. Stoller, 1992 Symposium held in Nashville Tennessee June 1990 Almost two thirds of these 91 papers are authored by researchers outside of the US including information on research in the former USSR Japan and Europe Topics include current commercial power reactor systems microstructural characterization Materials and Water Chemistry for Supercritical Water-cooled Reactors David Guzonas, Radek Novotny, S. Pentilla, Aki Toivonen, Wenyue Zheng, 2017-10-31 Materials and Water Chemistry for Supercritical Water cooled Reactors is unique in that it brings together materials and water chemistry their interrelationship the historical perspective and their application to SCWR conceptual design Written by world's leading experts all active in the area of materials and chemistry R D in support of GEN IV SCWR this book presents for the first time a comprehensive reference on these topics and in particular how these data relate to the SCWR design itself This book is an essential text for researchers in the areas of supercritical water cooled reactor materials and chemistry working in industry or academia It will also give newcomers to the field a survey of all of the available literature and a clear understanding of how these studies relate to the design of the SCWR concept The material presented is at a specialist's level in materials or corrosion science or in water chemistry of power plants Provides comprehensive coverage of the chemistry and materials of SCWR Presents the latest research and results condensed into one book Covers the differences in use of SCW in nuclear reactors and fossil plants and the resulting differences in materials requirements Fundamentals of Radiation Materials Science GARY S. WAS, 2016-07-08 The revised second edition of this established text offers readers a significantly expanded introduction to the effects of radiation on metals and alloys It describes the various processes that occur when energetic particles strike a solid inducing changes to the physical and mechanical properties of the material Specifically it covers particle interaction with the metals and alloys used in nuclear reactor cores and hence subject to intense radiation fields It describes the basics of particle atom interaction for a range of particle types the amount and spatial extent of the resulting radiation damage the physical effects of irradiation and the changes in mechanical behavior of irradiated metals and alloys Updated throughout some major enhancements for the new edition include improved treatment of low and intermediate energy elastic collisions and stopping power expanded sections on molecular dynamics and kinetic Monte Carlo methodologies describing collision cascade evolution new treatment of the multi frequency model of diffusion numerous examples of RIS in austenitic and ferritic martensitic alloys expanded treatment of in cascade defect clustering cluster evolution and cluster mobility new discussion of void behavior near grain boundaries a new section on ion beam assisted deposition and reorganization of hardening creep and fracture of irradiated materials Chaps 12 14 to provide a smoother and more integrated transition between the topics The book also contains two new chapters Chapter 15 focuses on the fundamentals of corrosion and stress

corrosion cracking covering forms of corrosion corrosion thermodynamics corrosion kinetics polarization theory passivity crevice corrosion and stress corrosion cracking Chapter 16 extends this treatment and considers the effects of irradiation on corrosion and environmentally assisted corrosion including the effects of irradiation on water chemistry and the mechanisms of irradiation induced stress corrosion cracking The book maintains the previous style concepts are developed systematically and quantitatively supported by worked examples references for further reading and end of chapter problem sets Aimed primarily at students of materials sciences and nuclear engineering the book will also provide a valuable resource for academic and industrial research professionals Reviews of the first edition nomenclature problems and separate bibliography at the end of each chapter allow to the reader to reach a straightforward understanding of the subject part by part this book is very pleasant to read well documented and can be seen as a very good introduction to the effects of irradiation on matter or as a good references compilation for experimented readers Pauly Nicolas Physicalia Magazine Vol 30 1 2008 The text provides enough fundamental material to explain the science and theory behind radiation effects in solids but is also written at a high enough level to be useful for professional scientists Its organization suits a graduate level materials or nuclear science course the text was written by a noted expert and active researcher in the field of radiation effects in metals the selection and organization of the material is excellent may well become a necessary reference for graduate students and researchers in radiation materials science L M Dougherty 07 11 2008 JOM the Member Journal of The Minerals Metals and Radiation Induced Changes in Microstructure, 1987 Symposium on Electron Metallography **Materials Society** Residual and Unspecified Elements in Steel Albert S. Melilli, 1989 Papers of the Symposium on title Nov 1987 Bal .1960 Harbor Fla detailing the state of the art on residual and unspecified elements in steel from manufacture to end use Includes practical examples from industry of beneficial as well as detrimental effects on properties associated with residuals Pro Review Oak Ridge National Laboratory,1985 Effects of Radiation on Materials Arvind S. Kumar, 1994

Proceedings of the 18th International Conference on Environmental Degradation of Materials in Nuclear Power Systems - Water Reactors John H. Jackson, Denise Paraventi, Michael Wright, 2018-12-20 This two volume set represents a collection of papers presented at the 18th International Conference on Environmental Degradation of Materials in Nuclear Power Systems Water Reactors The purpose of this conference series is to foster an exchange of ideas about problems and their remedies in water cooled nuclear power plants of today and the future Contributions cover problems facing nickel based alloys stainless steels pressure vessel and piping steels zirconium alloys and other alloys in water environments of relevance Components covered include pressure boundary components reactor vessels and internals steam generators fuel cladding irradiated components fuel storage containers and balance of plant components and systems

Effects of Radiation on Materials D. S. Gelles,1996 Nuclear Fusion Programme: Annual Report of the Association Karlsruhe Institute of Technology/EURATOM; January 2013 - December 2013 Pleli, Ingrid,2015-03-18

Influence of Radiation on Material Properties F. A. Garner,1987 Strength of Metals and Alloys (ICSMA 8) P. O. Kettunen, T. K. Lepistö, M. E. Lehtonen, 2013-10-22 Containing almost 250 technical and review papers these proceedings form an authoritative state of the art review of this important multidisciplinary topic Emphasis is placed on the study of the strength of mechanical properties of materials and their dependence on the microstructure and defect arrangements Areas covered include dislocations dislocation arrangements plastic deformation strengthening mechanisms cyclic deformation and fatigue plastic deformation at high temperatures fracture modern strengthening methods in steels boundaries and interfaces

Radiation Embrittlement of Nuclear Reactor Pressure Vessel Steels Lendell E. Steele,1993 Nuclear Materials ,2020-07-22 Materials in a nuclear environment are exposed to extreme conditions of radiation temperature and or corrosion and in many cases the combination of these makes the material behavior very different from conventional materials This is evident for the four major technological challenges the nuclear technology domain is facing currently i long term operation of existing Generation II nuclear power plants ii the design of the next generation reactors Generation IV iii the construction of the ITER fusion reactor in Cadarache France iv and the intermediate and final disposal of nuclear waste In order to address these challenges engineers and designers need to know the properties of a wide variety of materials under these conditions and to understand the underlying processes affecting changes in their behavior in order to assess their performance and to determine the limits of operation Comprehensive Nuclear Materials Second Edition Seven Volume Set provides broad ranging validated summaries of all the major topics in the field of nuclear material research for fission as well as fusion reactor systems Attention is given to the fundamental scientific aspects of nuclear materials fuel and structural materials for fission reactors waste materials and materials for fusion reactors. The articles are written at a level that allows undergraduate students to understand the material while providing active researchers with a ready reference resource of information Most of the chapters from the first Edition have been revised and updated and a significant number of new topics are covered in completely new material During the ten years between the two editions the challenge for applications of nuclear materials has been significantly impacted by world events public awareness and technological innovation Materials play a key role as enablers of new technologies and we trust that this new edition of Comprehensive Nuclear Materials has captured the key recent developments Critically reviews the major classes and functions of materials supporting the selection assessment validation and engineering of materials in extreme nuclear environments Comprehensive resource for up to date and authoritative information which is not always available elsewhere even in journals Provides an in depth treatment of materials modeling and simulation with a specific focus on nuclear issues Serves as an excellent entry point for students and researchers new to the field Fusion Energy Update ,1984 Effects of Radiation on Materials Margaret L. Hamilton, 2000

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