
Radiološka zaščita - Minimalna merila za spektroskopijo z elektronsko paramagnetno resonanco (EPR) za retrospektivno dozimetrijo ionizirnega sevanja - 2. del: Dozimetrija človeške zobne sklenine ex vivo (ISO 13304-2:2020)

Radiological protection - Minimum criteria for electron paramagnetic resonance (EPR) spectroscopy for retrospective dosimetry of ionizing radiation - Part 2: Ex vivo human tooth enamel dosimetry (ISO 13304-2:2020)

Strahlenschutz - Mindestanforderungen an die Elektronenspinresonanz (EPR-Spektroskopie) für die retrospektive Dosimetrie ionisierender Strahlung - Teil 2: Ex-vivo-Dosimetrie des menschlichen Zahnschmelzes (ISO 13304-2:2020)

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Radioprotection - Critères minimaux pour la spectroscopie par résonance paramagnétique électronique (RPE) pour la dosimétrie rétrospective des rayonnements ionisants - Partie 2: Dosimétrie ex vivo à partir de l'émail dentaire humain (ISO 13304-2:2020)

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**Radiological protection — Minimum
criteria for electron paramagnetic
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retrospective dosimetry of ionizing
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Ex vivo human tooth enamel
dosimetry**

*Radioprotection — Critères minimaux pour la spectroscopie par
résonance paramagnétique électronique (RPE) pour la dosimétrie
rétrospective des rayonnements ionisants —*

Partie 2: Dosimétrie ex vivo à partir de l'émail dentaire humain

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ISO 13304-2:2020(E)

Introduction

Electron paramagnetic resonance (EPR) or electron spin resonance (ESR) is an approach for retrospective dosimetry of exposure to ionizing radiation in any situation where dosimetric information is potentially incomplete or unknown for an individual. EPR is a tool for retrospective evaluation of doses, pertinent as well for acute and protracted exposures in the past or recently. Doses estimated with EPR were used to correlate the biological effect of ionizing radiation to received dose, to validate other dosimetry techniques or methodologies, to manage casualties, or for forensic expertise for judicial authorities.

EPR dosimetry is based on the fundamental properties of ionizing radiation: the generation of unpaired electron species (e.g., radicals) proportional to absorbed dose. The technique of EPR specifically and sensitively detects the unpaired electrons that have sufficient stability to be observed after their generation. The amount of the detectable unpaired electrons is proportional to the total amount that were generated, and hence to the absorbed dose. These species can interact with microwaves generating the EPR signal, and therefore the relationship between the intensity of the EPR signal and the radiation dose should be established.

The most extensive use of EPR in retrospective dosimetry has been with calcified tissue, especially with enamel from teeth. EPR dosimetry is one of the methods of choice for retrospective evaluation of doses to the involved populations from the atomic weapon exposures in Japan, after the Chernobyl accident and radioactive releases of the Mayak facilities in the Southern Urals.

This document provides a guideline to perform the *ex vivo* measurements of human tooth enamel samples by X-band EPR for dose assessment using documented and validated procedures. The minimum requirements for reconstructing the absorbed dose in enamel, by defining precisely the technical aspects of preparing enamel samples, recording EPR spectra, assessment of radiation induced EPR signal, converting EPR yield to dose and performing proficiency tests, are described. Retrospective dose assessment using EPR has relevance in radiation effect research, validating radio-epidemiological dosimetry systems, medical management, and medical/legal requirements.

A part of the information in this document is contained in other international guidelines and scientific publications, primarily in the International Atomic Energy Agency's (IAEA) technical reports series on "Use of electron paramagnetic resonance dosimetry with tooth enamel for retrospective dose assessment"^[1]. However, this document expands and standardizes the measurement and dose reconstruction procedures and the evaluation of performance.

This document is compliant with ISO 13304-1^[2] with particular consideration given to the specific needs of X-band EPR dosimetry using human tooth enamel.