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Study about the radionuclides implanted on glass surfaces for the estimation of retrospective indoor radon concentrations

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Content

Retrospective dosimetry due to indoor radon exposure requires measurement methods allowing the determination of mean radon concentrations in the past. One of the such methods is based on the direct measurement of 210Po implanted on the surface of objects, whose activity concentration (Bq/m2), is directly related to the cumulative exposure due to the concentration of 222Rn (Bq/m3) for long time. These determinations are possible taking into consideration the equilibrium between 210Po (T1/2 = 138.378 days) and its parent 210Pb (T1/2 = 22.3 years), being both radionuclides from the 222Rn progeny. In a previous work [1] about the determination of the conversion factor (ratio between the concentration of 210Po in objects and the retrospective 222Rn concentration in air), corresponding equilibria between descendants were assumed. In this work, an experimental study about the equilibrium 210Pb - 210Po in glasses, which were previously exposed to considerable radon concentrations, has been performed. Two scenarios were studied: a place without, and another place with, continuous cumulative 222Rn concentration. In the first site, a mirror was exposed for a short time (4 months) to an environment with very high radon concentration (about 30 kBq/m3), whereas in the second case, a similar mirror is being exposed since July 2011 (and now it continues) in a room with moderate radon concentration (about 200 Bq/m3). Both mirrors are being measured from time to time by alpha-particle spectrometry in order to determine the 210Po concentration in the surface. Experimental results are being compared with those reached by theoretical calculations from the activity evolution equations. The results reached in the measurement of the first mirror, short-time exposed to a great radon concentration, can be only explained considering an extra quantity (not only that due to recoil implantation) of 210Po in the mirror surface. This extra 210Po concentration on the surface glass should appear by additional implementation of 210Bi and 210Po, produced by electrostatic attraction process. This effect is only predominant when the mirror is exposed in an environment composed by a large number of nuclides. In the case of the mirror submitted to a moderate long-time radon concentration, studies are more tedious due to the low-level concentration found in the glass surface. Preliminary results seem to be in agreement with the theoretical predictions expected for these conditions. In our case, five years is the time estimated to reach values above the limit of detection of the experimental device used. In this time, however, the incidence of extra 210Po added by electrostatic effects is lowered to a quantity less than 10%. Anyway, the assignment of correct values for the conversion factor is completely necessary to adequately estimate retrospective radon dose. Only in this way, any correlations between the effects caused by indoor radon concentrations to the human health should be accurately assessed.
[1] Martín Sánchez, A., de la Torre Pérez, J., Ruano Sánchez, A.B. Experimental studies about the ratio between 210Po deposited on surfaces and retrospective indoor 222Rn concentrations. Radiat. Prot. Dosim. 160, 206-209 (2014).

About the Presenter

Prof. Dr. Alejandro Martín Sánchez is a teacher at the Department of Physics in the University of Extremadura (Spain). His studies were performed at the Universities of Madrid and Extremadura (Spain), although his formation was completed in several international institutions (The University of Calgary, CERN, Lund Institute of Technology, Universitá degli study di Parma, Turku Politechnique, and several Spanish universities). He has an experience of more than 35 years working with radioactivity and radionuclides. His studies have been devoted to the characteristics of actinides, alpha-particle spectrometry, nuclear structure, or environmental radioactivity. In the last time he has been working with indoor Radon measurements. He has more than 120 research papers

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