The effect of backscattering on the beta dose absorbed by individual quartz grains

We describe the effect on dose rates and over-dispersion (OD) of changing the spectrum of energies to which grains of various shapes and volumes are exposed during beta irradiation, either by changing the backscattering medium or attenuating the incident spectrum. Dose rates are found to increase when the atomic number of the backscattering substrate is increased (from 0.038 Gy/s on Al to 0.057 Gy/s on Pb), at the same time the dispersion due to grain shape and volume also increases slightly (9.4% on Al and 12.0% on Pb). By adding attenuators in front of the sample the net spectrum is also altered and the dispersion affected correspondingly. Our model prediction using various grain shapes and volumes are compared with experimental observations using sieved natural grains and the resulting dose rates are in good agreement, although the dispersions cannot be realistically compared in the absence of grain shape information for the natural material. We find from modelling that dose rates (both to grains in single grain discs and to those placed on the backscattering substrates) are sensitive to changes in shape and volume. A relative range across shapes of between 10 and 21% is observed from modelling on backscattering substrates, and of 7.4% from modelling in single grain discs. We conclude that it appears to be desirable to minimise shape and volume variations in grains if over-dispersion is also to be minimised.

General information
Publication status: Published
Organisations: Center for Nuclear Technologies, Radiation Physics, Université Bordeaux Montaigne, Aarhus University
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Pages: 491-497
Publication date: 2017
Peer-reviewed: Yes

Publication information
Journal: Radiation Measurements
Volume: 106
ISSN (Print): 1350-4487
Ratings:
BFI (2017): BFI-level 1
Scopus rating (2017): CiteScore 1.33 SJR 0.509 SNIP 1.094
Web of Science (2017): Impact factor 1.369
Web of Science (2017): Indexed yes
Original language: English
Keywords: Attenuation, Backscatter, Beta spectrum, Dose deposition, Geant4, Modelling
DOIs:
10.1016/j.radmeas.2017.05.004
Source: FindIt
Source ID: 2358690547
Research output: Contribution to journal › Journal article – Annual report year: 2017 › Research › peer-review