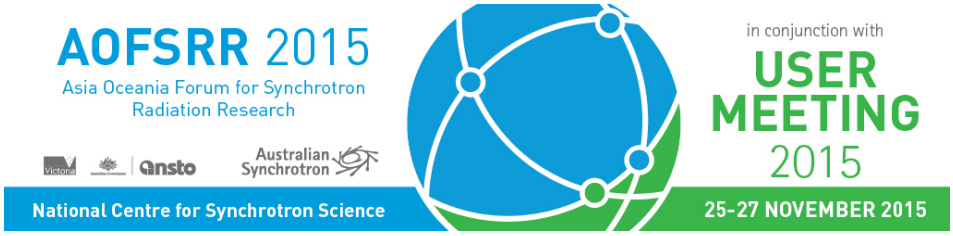

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Dual Energy X-ray Analysis Using Synchrotron Computed Tomography at 30–100 keV

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Dual energy X-ray analysis (DEXA) uses computed tomography (CT) measurements at two photon energies to characterise the density and composition of materials. Results are expressed as the electron density (*Ne*) and fourth statistical moment (*R4*) describing the elemental composition similar to the concept of effective atomic number. The accuracy of the technique was investigated for liquid samples of known density and composition; aqueous ethanol and salt solutions.

CT scans were conducted with near mono-energetic radiation of 30 to 100 keV. The radiation dose delivered by each scan was 4-9 mGy, approximately 50% of that for medical CT. Reconstruction used filtered back projection with a ramp filter to 0.2 mm pixel size. For individual slices the noise to signal ratio (NSR) was 3.2-8.4%. Analysis used the mean of 40 summed slices with an NSR of 0.8-1.9%.

The measurements were combined to obtain coefficients describing the compositional dependence of elemental cross-sections. DEXA considered all 34 materials and 45 permutations of beam energies separated by 5 keV to 70 keV. The difference between DEXA results and true values improved with wider energy separations reaching approximately 0.5% (one standard deviation) for separations 20 keV or more. Propagation of errors analysis was employed to quantify contributions from random and systematic errors, accounting for the observed accuracy of the technique. The applications for DEXA are sample characterisation and predicting interaction coefficients at other photon energies for attenuation correction and radiation dosimetry calculations.

Keywords

x-ray computed tomograpy, electron density, composition

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