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Controlled density tracers for Positron Emission Particle Tracking (PEPT)

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Positron Emission particle tracking (PEPT) is a non-invasive nuclear imaging technique used to investigate the dynamics of opaque granular and multiphase flowing systems. The basis of PEPT is to attach a sufficient positron emitting isotope to a selected particle to act as a representative of the bulk material under study for a system of interest. The resultant gamma photon pairs produced by the electron-positron annihilation within the particle are used to trace the particle's flow path within millimeter precision at millisecond intervals or better.

Novel tracer particle production techniques have been developed at PEPT Cape Town implementing a 68Ge/68Ga generator for a positron supply along-side ion exchange resins which have been manipulated to selectively absorb 68Ga. Ion exchange resins are used to fabricate tracer particle analogues of the materials used in systems of interest. It is critical that the produced radiotracer behave the same as the bulk material of interest, motivating the need for techniques that finely control both the particle size and density of the tracer to match the materials under investigation.

Application specific tracer particles are produced over a density range typically between 1.00 and 2.85 g/cm3 with final particle diameters of 350 microns and larger. These particles are representative of a range of industrially relevant materials including silica, metal ore and ceramics. We report on standardised methods for creating density-modified tracer particles to expand the range of applications feasible to research with the PEPT technique.

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