

Using an electron linac to improve the sustainability of diamond mining

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We report on the successful test for locating diamonds in ore by using an electron linac to create the ^{11}C isotope atoms via the (γ, n) reaction which has a large cross-section (8mb) at the Giant Dipole Resonance. The ^{11}C atoms can be detected consequently using the Positron Emission Tomography (PET).

The technology is presently being scaled up for deployment in a mine with the goal of discovery diamonds in the kimberlite ore grade. The typical run-of-mine throughput of several hundred tons per hour requires a high-power electron linac paired with high rate-capacity PET detectors system. 100% concentrate can be achieved followed by an intelligent diamond recovery process. Besides reducing breakage, the technology is waterless and greener. The mine lifetime will be extended, and marginal mines become viable.

The design of the linac has converged to $E_e = 45\text{MeV}$ at 200 kW in the beam. Ruggedness in the mining environment dictates a warm Cu, S-band machine. The system can produce the required PET activity of 2 kBq/cm³ measured after a 30 min decay out of a FIFO storage to leave ^{11}C as the dominant PET isotope. The technology is termed MinPET and is currently under study. This contribution details the linac design component of the project.

Footnotes

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