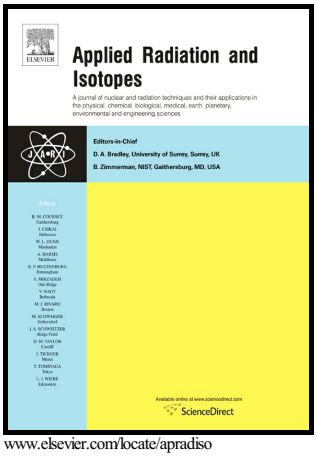

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Modeling the pressure rise of a liquid target on a medical cyclotron: Steady-state analysis

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Abstract

The steady-state behaviour of a liquid target used to produce medical isotopes by low-energy cyclotrons is studied. A model based on the conservation of mass and energy is proposed to describe the pressure rise of the target assuming equilibrium between liquid and vapour phases during irradiation. The effects of water radiolysis are taken into account. Excellent agreement is achieved between the model and both constant-temperature bath tests and experiments conducted on a 13 MeV cyclotron at TRIUMF.

Keywords: *Liquid target*, *Steady-state*, *Thermal modeling*, *Water radiolysis*, *PET isotope*.

1. Introduction

Production of radionuclides and their corresponding radiopharmaceuticals in cyclotron facilities is fundamental for nuclear medicine. In-vivo molecular imaging and visualizing functional physiological processes and metabolic activities in the human body using Positron Emission Tomography (PET) depend on the production of short-half life ($<$ 10 hours) radioisotopes. Medical isotopes are commonly produced in cyclotrons with incident beam energies ranging from 7-30 MeV using targets comprised of gas, liquid or solid materials (Helus (1983); Ruth (2009); Buckley et al. (2000, 2004); Hoehr et al.

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