

Development of a Positron Source

A. N. de Souza¹, T. M. Casagrande¹, M. J. Brunger², J. Sullivan³, S. Buckman³, M. C. A. Lopes*¹

¹Departamento de Física, Universidade Federal de Juiz de Fora, MG, Brasil

²Chemical and Physical Sciences, Flinders University, SH, Australia

³Research School of Physics and Engineering, Australian National University, Australia

Synopsis. In this work we report the development of a sealed capsule of ^{22}Na with the goal of producing low energy positron beams for use in the apparatus available at UFJF, nowadays applied in the study of electron collisions with molecules.

Experimental research using low energies charged particles beams is not a simple task, even when we are working with electrons. The production of these intense beams, focused, with high energy resolution, implies working in extreme sensitivity conditions, once that they are highly susceptible to electric and magnetic fields, the vacuum conditions, the electron optics used, the materials applied in the spectrometer and also, the stability of its control electronics. For the production and use of positron beams in the study of molecules, it is added new difficulties to those mentioned, starting with the fact that the positron is a particle much less applied in the field of science and the literature has limited data on the technology involved, making the development of the project a major challenge.

The simplest way to obtain positron is through its emission from radionuclides. It was developed in this work a sealed capsule of the ^{22}Na radionuclide, consisting of a positrons source for the new line of research of Atomic and Molecular Spectroscopy Laboratory (LEAM) - UFJF, which will enable the use of slow positron beams, rather than electrons, in the studies of atoms and molecules. The work involved several steps, such as the choice of the emission source of positrons, the design and construction of the sealed capsule, the development of the methodology for filling the capsule, its sealing, taking into consideration all the aspects inherent in radiological protection. The positron source chosen was the element ^{22}Na , due its long radioactive half-life (2.6 years) and reasonably low biological half-life (11 days). The process of filling the ^{22}Na capsule, shown in Figure 1, involved a loading table that permits fill the capsule respecting the radiation protection safety procedures.

The initial capsule loading and dryer test was made with an aqueous NaCl solution not radioactive with the same chemical specification of the radioactive solution.

For the dryer procedure of solution was initially used an infrared lamp. However was verified a formation of a NaCl aureole in the top of Ta cup, where the ^{22}Na is deposited in the capsule. Another observed problem was that the time required to dry each drop was about 10 minutes, implying in an exposure time too long to load all Ta cup. Seeing to obtain a homogenous deposition of the sodium solution in the Ta cup, the infrared lamp was replaced by a heat gun, observing the same temperature in the cup during the dryer procedure, about 60°C in both processes.



Figure 1: a) Loading table for the ^{22}Na capsule source and its sealing procedure

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* E-mail: cristina.lopes@ufjf.edu.br