Australian Surgical Radiation Probe (SRP) Designed and Manufactured in Australia

CASE STUDY

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Introduction

When manufacturing leaders of high technology overseas are about to start working on QUANTUM computers, the principal of molecules in a liquid held in magnetic fields by taking advantage of nuclear magnetic resonance which will make todayís modern computer a thing of the past in the non-distant future. We at Gammasonics have spent the last two years developing the Australian made Radiation Surgical Probe (SRP).

Applications

Used by the surgeon to identify tissue containing radioisotopes. For the following:

- Sentinel lymph node localisation.
- Osteoid Osteomas (Bone Cancer)
- Cancerous Tissue

Sensitivity

To the following isotopes:

- Tc-99, I-125, In-111 and to have a ranging from 27-364 keV.

Specification

- Crystal Material CsI(T1)
- Dimensions approx 15 cm long
- Diameter approx 14 mm
- Angle of approx 25 degrees as horizontal plan
- Material to be of surgical quality or 316 Stainless Steel
- Weight to be between 200g and 500g max. (present unit 350g)
- Operating temperature maximum of 50 degrees Celsius
- Sterilisation utilising Ethanel Oxide

History

CHOOSING THE SCINTILLATOR MATERIAL -CAESIUM IODIDE CsI(T1)

Caesium Iodide was chosen for the following reasons:

It is a material with a high gamma ray stopping power due to its relative high density and atomic number. For scintillation counting it is used either in its undoped form or doped with sodium or thallium. CsI is noted for its high resistance to thermal and mechanical shock due to the absence of a cleavage plane.

Most physical characteristics of CsI are independent of the activator used. Compared to NaI(T1), it is relatively soft plastic and can be easily fabricated into a variety of detector geometerics.

Because of its rugged character, CsI has been extensively used for well logging, space research for other applications where severe shock conditions are encountered.

CsI itself is soluble in water but is not hygroscopic in the real sense. However, when in contact with materials to which water vapor can adhere, or when used in atmospheres with a high relative humidity, surface degradation can occur. For undoped CsI and CsI(T1), resurfacing the crystal will generally restore the original performance. CsI (Na) is hygroscopic and must be hermetically sealed at all times just as NaI(T1).

After we have defined our parameters and our requirement we also need to investigate the components and materials easily available in Australia. We must recognise that Australia is not in the race or monopoly of producing scintillators or products of similar technology.

We need to start from scratch by evaluating different types of crystals. Common practice is to evaluate scintillators by comparing it to Sodium Iodine Thallium detectors (NaIT1). However, this practice of NaI(Ti) as a standard scintillator is a practice from the user point of view but from the measurement view point it is far from being an ideal situation.

Even samples taken from the same ingot do not have identical scintillation properties. Sample to sample varies and they are heavily influenced by the impurity activators, distribution, surface preparation and casing procedures. Some attempts have been made at determining the absolute scintillation efficiency of NaI(T1) but these efforts have had to contend with the problem in Photomultiplier (PMT) and the sensitivity, calibration, resolution of the sample. Up to its representation of normacy under the determination of the emission spectrum of the fast (0.25 msec) component there is a definite need to define some sort of absolute standard to which all scintillators can be compared.

Because we are using a semiconductor detector in conjunction with CsI(T1) crystal we have eliminated the high voltage which has been some of the problem encountered by the overseas manufacturers.

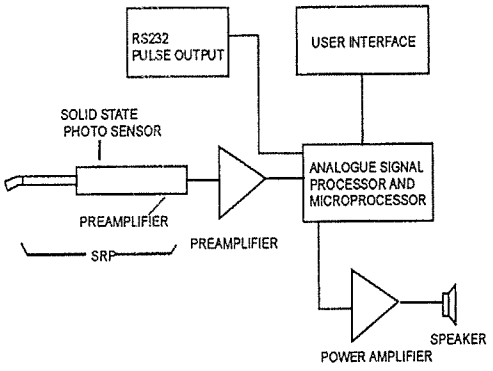

Figure 1: Block diagram of SRP and processor unit.

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Again our semiconductor is attached to the preamplifier leaving us with an amplifier and a microprocessor control display unit.

Leaving physics behind we move into the testing procedures that we have utilised to determine the performance of our SRP. The apparatus used to perform the test is described in Figure 1.

Collimation

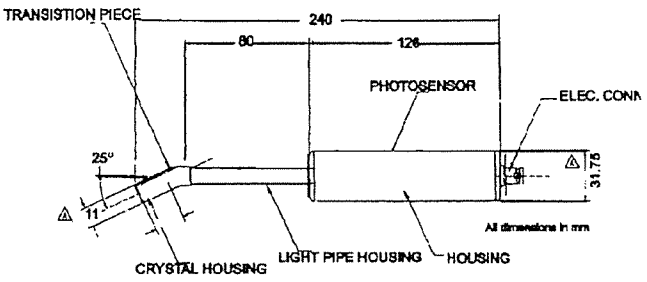
To make the unit more directional we are currently designing a small insertion made of Tungsten shielding to produce different types of collimations. This is in co-operation with the School of Physics at Wollongong University putting us in a different dimension to our overseas competitors as we will be able to offer custom made collimators for different applications.

The Amplifier and Reader

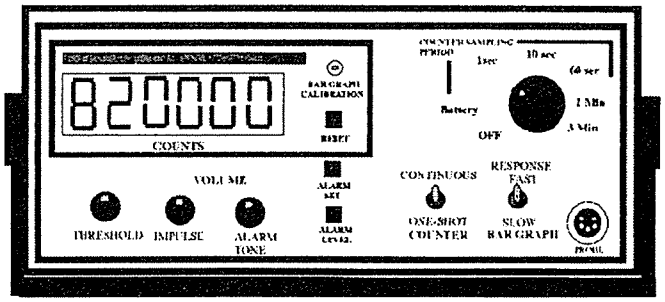
It could have been easier to duplicate an imported product utilising their experience failures and success but we decided to design and make a product which can be called the Australian SRP. Not only producing the probe but also designing an amplifier counter and reader, here again we encountered several problems on the research stage and to secure electronic components at a reasonable price in Australia that was another task that needed to be overcome as 7 per cent of electronic equipment is manufactured overseas compared with the United States where most of the components are all available from the shelf Australia does not have this industry and all these components need to be imported especially for this application.

Overcoming all these hiccups and inconvenience we are still making a system at a good price and quality. During the last two years of developing we have manufactured three different prototypes. We have developed a software package that will allow us to use the SRP MK II with a slight modification to be operated from a laptop that will allow enhance clinical experience and demonstrates the difference in techniques utilised in the field.

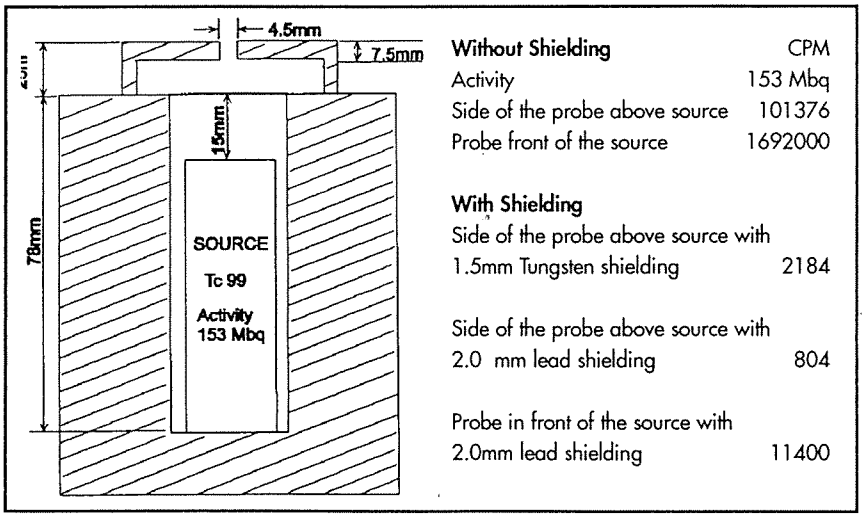
Our amplifier has been made utilising simplicity but performance required in a Department of Surgery. Our SRP MK II is now listed under the Therapeutic Goods Administration (TGA) in Australia this gives us the input that we need in Asia to promote Australian products.



Surgical Radiation Probe (SRP)



Amplifier unit



Experimental apparatus

Surgical Trial

Surgical trial has been performed by several parties across Australia but only recently we had our own experience by attending a surgical session conducted by Professor David Gillette at Concord Hospital, a three hour session in which the SRP Gammasonics Probe was compared side by side with the C-Track probe. We were happy to see that our unit demonstrated the same performance to the imported product with an advantage that our probe is narrow and is slightly more sensitive. Adding our extra shielding capping makes the Gammasonics probe more directional and can narrow beam smaller tissue sections.

The C-Track includes a louder alarm and a foot pedal to turn the unit on and off, these facilities are now available in the Gammasonics SRP not mentioning future advantages available from our SRP.

Clearly demonstrated that the technology of utilising a narrow beam radiation detector helps the surgeon to make a far more precise surgery.

Precautions

1. The plastic cover sleeve normally

utilised on these probes to maintain sterilisation can become contaminated with radiation when the probe has been inserted into the incision or when the masses have been removed or biopsy is performed utilising the probe. This can produce radiation peaks or show presence of radiation giving misleading information.

To prevent this situation from occuring we recommend that Radiacwash or Decon 90 should be made available in the theatre to cleanse the sleeve and then to be rinsed with sterilised water before re-inserting into the patient.

2. We are currently talking to an American manufacturer of Surgical Gloves which contains a percentage of lead. The gloves are reusable after sterilisation this will help the surgeon to protect themselve from long exposure time to the isotope.

Conclusion

We are quite confident that as the technique gains momentum in Australia and neighbouring countries our efforts will be well rewarded.

Number of forseeable installations in Australia is between 50 – 100 however, in Asia, Nuclear Medicine is just beginning to emerge where the market is big for the future this is an excellent situation for Australian teaching institutions and hospitals gaining the experience to be able to participate in the future as the teachers of the technique.

Not forgetting other products already manufactured by Gammasonics in Australia such as the first Australian commercially available Radiation Survey Meter in 1992 the Australrad Area Monitor which are currently being used not only in Australia but also in Asia and Europe.

In 1996 in the area of Radiotherapy our Brachytherapy Gammatron 192 with an immense potential among the Asian countries just to mention some of the products that have been produced without any government financial support.

In 1998 not only the SRP but also our new Radiation Calibration Facility which is currently being updated (undergoing NATA accreditation) and is to be moved into new premises that are currently under construction. Gammasonics will have the capability to calibrate kVp measurement equipment utilising Diagnostic X-ray, Mammography and our existing Gamma and Beta calibration will also be enhanced during 1998-1999.

Acknowledgement

We take this opportunity especially to thank all of those who have encouraged us and supplied us with ideas and positive comments after assessment and those that have committed themselves by placing orders.

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