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Laser Fluorescence for Detecting Thorium and Uranium in Acrylic

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1 Introduction

Finding the concentration of thorium and uranium in acrylic has proved difficult. Methods that have been used so far involve distructive testing. Laser fluorescence as a method of detecting these contaminents provides some significant advantages.

Since the acrylic is transparent it invites the use of optical techniques for contaminent analysis. Also, if optical methods work, the material is not destroyed. Furthermore, it is typical of optical methods that the length of time required for a measurement is short— typically less than one hour.

On the pessimestic side, since the host for the thorium and uranium, *i.e.*, the acrylic, is a non-crystalline solid it can be expected that the atomic transitions, particularly those involving outer electrons, will be fast, and so line broadening will occur, thus reducing the sensitivity of the method. However the potential advantages made it worth a try.

2 Method

A sample of acrylic was sent to Photon Technology International in London, Ontario. The sample was irradiated by a laser and the eminating light was analysed with a spectrometer. The exciting wavelength was scanned from ???nm to ???nm in steps of 20?? nm.

3 Results and Conclusions

In general the acrylic was found to be a "clean" substance. Several bands were seen but no identification could be made with either thorium or uranium. However it is also true that predicting what thorium and uranium should look like in the acrylic host is not a simple excercise. And at the level of interest, acrylic is loaded with many elements.

The level of sensitivity that was achieved with this method is about 10^{-9} molar, and this is not sufficient for the SNO experiment. It may be possible to improve the sensitivity but this will require work and/or money. Considering the timescale for SNO, this does not seem to be a good thing to persue. The apparatus used for this measurement as it stands is worth about $40k.

Another possibility for using optical methods might be to use a multi-photon excitation. Typically when experiments of this type have been done they give very specific signals: there is little chance of mis-identifying the element of interest. However, these are very complicated experiments so we would need to locate experts who are actually doing this kind of work.