Alpha Spectra, Inc.
WIMPScint and Ultra-low Background NaI(Tl) Detectors

In 2011 ASI began developing a new Ultra-Low Background NaI(Tl) material that could be used by scientists searching for WIMP-WIMP Dark Matter events. Providing extremely radiopure material that will achieve good signal-to-noise in the critical spectral regions of interest is a significant challenge.

It took us multiple iterations over several years to meet the strict low levels of radio-contamination that are required for the Dark Matter experiments. We accomplished this by improving our in-house purification process, our growth process and our detector encapsulation process. During this time, we worked with several DM collaborations to achieve our goal.

The main radiocontaminants of concern are: ^{238}U, ^{40}K, ^{232}Th, ^{210}Pb and total alpha rate. Our ultra-low background NaI(Tl) material is called WIMPScint material. Our WIMPScint-III material is now being used in several Dark Matter experiments around the world. Some of the reported results for WIMPScint-III are shown in Figure 1. The table shows an iteration in the improvement of the radiopurity of the material. We have grown some WIMPScint-IV material, but we do not have results for it at this time.

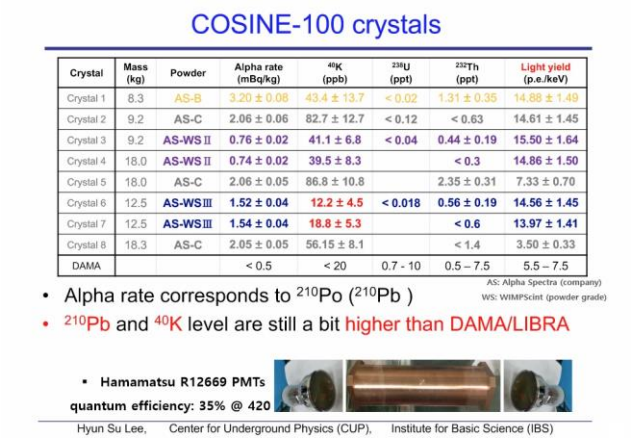

Figure 1. From Institute for Basic Science, Daejeon, Korea.

Here is a summary table for the data found in Figure 1. The first row of data is ASI WIMPScint-III material. The second row shows the reported results for material used in the DAMA-LIBRA experiment. The D-L material was manufactured by others.

^{238}U (ppt)	^{nat}K(^{40}K) (ppb)	^{232}Th (ppt)	α rate (mBq/kg)	Light Yield (pe/keV)
<0.018	18.8[1]	<0.079	1.54[1]	14.56[1,2]
0.7-10	<20	0.5-7.5	<0.5	5.5-7.5

[1]The higher value reported is shown here.
[2]Preliminary Results of ANAIS-25 reports a value of 16.13.

Except for the α background, the results reported show that the ASI material is equivalent or substantially better. Our light yield is outstanding due to the chemical purity of the starting material. We have reduced self-absorption of light in the bulk material. Taking the results from the DM collaborations and correcting for the quantum efficiency of the PMT gives absolute light yield values from 40,000 to 50,000 photons/MeV.

Figure 2. Photo courtesy of the Cosine Experiment, Institute for Basic Science, Daejeon, Korea.

The photo in Figure 2 shows our ASI detectors immersed in the experimental set up. The plastic super-structure is visible in this image. Immersion is appropriate because liquid scintillator surrounds the NaI(Tl) detectors used in this experiment in order to further improve the signal-to-noise ratio.

WIMPScint and Ultra-Low Background Detector
Photo Gallery

Figure 3. ANAIS WIMPScint Detectors.

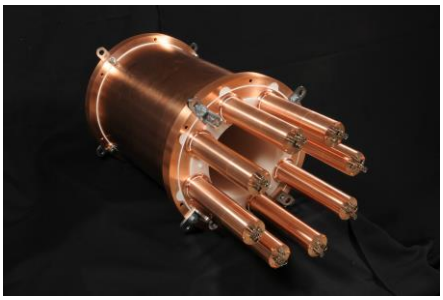

Figure 7. Ultra-Low Background Annular Detector.

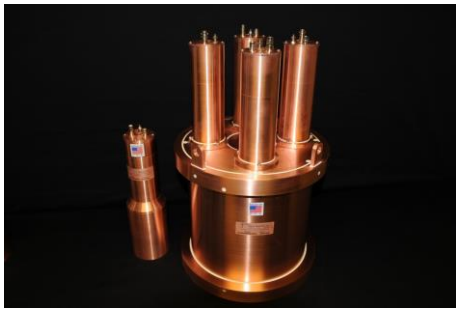

Figure 4. NaI(Tl) 9” x 9” Annulus and Plug Detector.

Figure 8. Ultra-Low Background Demountable Well Detectors.

Figure 5. COSINE-100 WIMPScint Detector.

Figure 9. In-House Machining Capability.

Figure 6. Integral Ultra-Low Background Detector.

Alpha Spectra, Inc.
SCINTILLATION DETECTORS
800-231-2545 . 970-243-4477 . 970-244-6947FAX
715 Arrowest Ct. Grand Junction, CO 81505
www.alphaspectra.com