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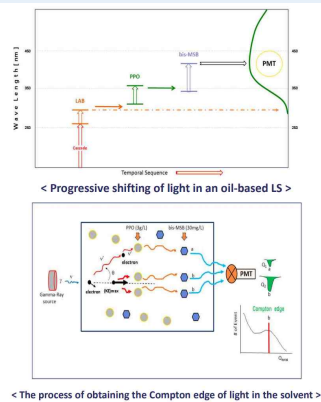
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Introduction & Motivation

- Liquid scintillator (LS) is used in various fields such as nuclear, particle physics and medical physics.
- LS is diluted by mixing oil with the base solvent, and fluor is added to make the light emission.
- In general, a surfactant (SF) is used to mix water and oil in the LS.
- Alcohol and acetone can be used to make LS without SF.
- Fluor is 2,5-diphenyloxazole ($C_{15}H_{11}NO$, PPO). Secondary wavelength shifter materials are 1,4-bis(5-phenyl-2-oxazolyl) benzene ($C_{24}H_{18}N_2O_2$, POPOP) & 1,4-bis(2-methylstyryl)benzene ($C_{24}H_{22}$, bis-MSB).
- Water has a density of 1.0 g/cm^3 , 2-Ethoxyethanol (2-E) is 0.93 g/cm^3 , and acetone is 0.79 g/cm^3 . Alcohol and acetone have similar densities to water when mixed with water.
- Contrast agent is a solution and mixes well with acetone. It also has good attenuation of X-ray. In addition, the contrast agent is harmless to the human body.
- Density can be measured using a density meter, but the uniform density can be known using Computed Tomography (CT) image.
- Finally, the physical characteristics of the LS can be measured using medical physics devices.

What is the liquid scintillator (LS) ?

Base solvent	<ul style="list-style-type: none"> PC (Pseudocumene, $C_{10}H_{12}$) LAB (Linear Alkyl Benzene, C_nH_{2n+2}, $n=10\sim13$) DIN (Di-isopropynaphthalene, $C_{20}H_{18}$) PXE (Phenyl-ethyl-ethane, 1,2-dimethyl-4-(5-phenyl-2-oxazolyl)benzene, $C_{24}H_{22}$)
Fluor	<ul style="list-style-type: none"> PPO (2,5-diphenyloxazole, $C_{15}H_{11}NO$) BPO (2-(4-biphenyl)-5-phenyl-oxazole, $C_{23}H_{15}NO$) PTF (terphenyl, $C_{18}H_{14}$)
Wavelength shifter (WLS)	<ul style="list-style-type: none"> bis-MSB (1,4-Bis (2-methylstyryl) benzene, $C_{24}H_{22}$) POPOP (1,4-Bis (5-phenyl-2-oxazolyl) benzene, $C_{24}H_{18}N_2O_2$)
New base solvent * 2-E (2-Ethoxyethanol, $C_4H_{10}O_2$) * Ac (Acetone, C_3H_6O)	



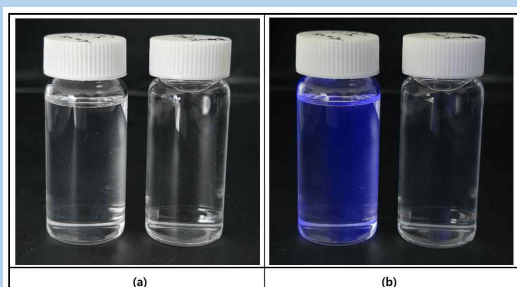
Synthesize of various new LS (with Contrast agent) using acetone



Sample #	Compositions of CbLS *	PPO Solubility
1	Contrast agent (80 mL), Acetone (20 mL), PPO (1.5 g/L)	Soluble
2	Contrast agent (90 mL), Acetone (10 mL), PPO (3 g/L)	Insoluble
3	[Contrast agent (80 mL) + PPO (3 g/L)], Acetone (20 mL)	Insoluble
4	Contrast agent (80 mL), [Acetone (20 mL) + PPO (3 g/L)]	Insoluble
5	Contrast agent (70 mL), Acetone (30 mL), PPO (3 g/L)	Soluble
6	Contrast agent (60 mL), Acetone (40 mL), PPO (3 g/L)	Soluble
7	Contrast agent (50 mL), Acetone (50 mL), PPO (3 g/L)	Soluble

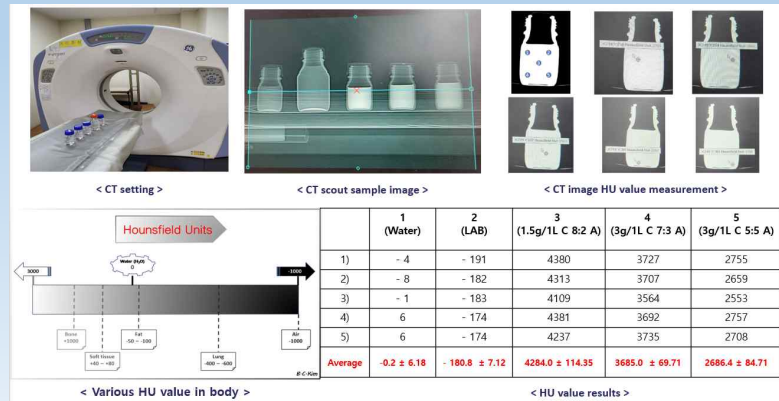
* CbLS = Acetone - based LS + contrast agent

UV irradiation test

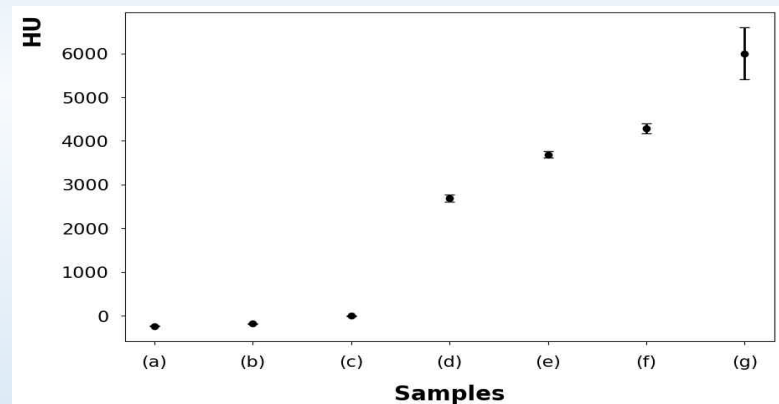


Light emission from (a) CbLS (left) and water (right) under visible light and (b) ultraviolet test conditions

Measurement of CT image and House field Unit (HU) value at CbLS



HU values of samples



(a) Acetone, (b) LAB, (c) Water, (d) CbLS(#7), (e) CbLS(#5), (f) CbLS(#1), (g) Contrast agent

Summary

- Investigate the possibility of using CbLS in dosimetry area of medical physics.
- CT image & HU values were measured.
- CbLS is expected to contribute to the improvement of particle therapy and general X-ray methods or technique in medical physics.
- Future plan : light output of CbLS and its applicator.

References

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