

Status of Thorium Fluoride Replacement Materials

Non-Radioactive Coating Materials for the Infrared

Thorium fluoride (ThF₄) has been the favored low-index IR coating material since its investigation and introduction 45 years ago. However, the radioactivity of Thorium (Th) led to forbidding the use of ThF₄ by the 1980's. With that loss, subsequent studies of different fluoride compounds were conducted by scholarly groups and coating companies who sought an alternate material that would exhibit ThF₄ transparency, physical durability, and affordable cost. Those who work in the spectral range above ~11 μm are already aware of suitable candidate replacements. [1, 2, 3, 4]. Although several substitute IR materials have been identified with comparable properties, none have equaled ThF₄. This article reviews the current industry and Materion's status and progress in the pursuit.



Depiction of coatings with the subtractive & additive combinations of colors produced by transmission through dichroic filters designed for the visible region.

(Photo Credit: S. Pellicori)

consideration for not meeting the highest efficiency and LDT applications. This leaves fluoride compounds for the low-index choices and zinc sulfide or zinc selenide and Ge for the high-index layers. Thus, optical coatings functioning in the thermal IR ("LWIR") are composed of a fluoride compound and a high-index material as cited above. The materials on this short list of candidates are deposited using thermal evaporation sources such as resistance- heating or E-beam evaporation. (While sputtering and ion-beam deposition is possible, those processes are not generally used for IR coatings). As is true of all fluoride compounds, the replacements have been found to require special deposition process-dependent preparation and specific deposition parameters to provide optimal properties.

The isotope component of Thorium fluoride, Th²³², has an activity of 0.22 μCurie per gram, and emits alpha particles of 4 MeV energy, beta particles (electrons) of 0.012 MeV, and gammas at 0.0013 MeV energy. The alphas are stopped by a thickness of

Thorium Fluoride Properties: Desired and Not Desired

All optical coatings that are designed to provide specific functions such as reduction of surface reflection, isolation of a pass band, or definition of LW and SW separation edges, require the combination of low-index and high-index material layers. For IR wavelengths longer than ~7 μm, suitable materials are few in number as limited by absorption. In this region, Oxide compounds are eliminated from

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paper or by four inches of air. Betas can also easily be shielded against. The gammas, however, have higher penetrating power and pose a greater risk for tissue damage. Exposure by inhalation of ThF4 dust is the preeminent hazard faced by thin-film coating personnel.

Continue to read about [thorium fluoride replacement materials...](#)

Thorium Fluoride Substitutes - Alternative to Coming Regulations

For those who may be unaware, there are impending government hazardous materials regulations that will impact companies that deal with radioactive materials such as Thorium Fluoride (ThF4). The U.S. Nuclear Regulatory Commission released its proposed rule (Distribution of Source Material to Exempt Persons and to General Licensees and Revisions of General License Exemptions) in September 2010, and while no fixed date has been announced, it is expected the Final Rule could be published soon. From that point, there will be a one year period to come into compliance.

Materion would like to encourage our customers to become familiar with the pending regulations, which for the majority could mean an impact on how they do business. Among the requirements is the need to obtain a "specific" license at an increased cost, rather than the current "general" license most employ. Materion would like to stress the importance of companies (big and small) to review the financial and commercial aspects of the pending regulations and license requirements.



In addition, be aware that the regulations require an improved radiation safety program and more inspections. This represents other challenges, such as re-training employees to understand the new regulations, implementing a revised company program and perhaps adding staff. Materion's commitment to producing [Thorium Fluoride](#) will not cease with the new regulations. However, we will need to comply with the new requirements as regards the supply of material.

Depending upon your application, companies using ThF4 may opt to consider using non-radioactive alternatives. Materion features an ever expanding selection of specialty evaporation fluorides like YF3, YbF3, CeF3, BaF2, CIROM-IRX and LaF3 to name a few. We continue to invest in manufacturing capabilities and developing processes and expertise that allow these materials to be candidates for an increasing number of uses previously dominated by ThF4. Refinements in reaction technology, morphology, raw materials and an increasingly skilled Sales and Sales support structure have increased the role these critical materials and mixtures have in minimizing the risk to the marketplace of having no viable ThF4 alternatives.

Materion is pleased to offer our technical services and guidance in the use of ThF4 replacement products for specific processes and application needs. For further information please contact a Materion customer representative at www.Materion.com/advancedchemicals or call 414.289.9800.



Materion Advanced Chemicals would like to introduce Christopher Helwig, Sales Specialist since December 2012. Chris reports to Robert Dixon, Regional Sales Director, and works out of Materion's Milwaukee facility. While new to the company as "Specialist," Chris has been with Materion since 2009 and held several previous positions that uniquely qualify him for his current role. When he first started his career at Materion, Chris worked as a sizing technician in production, predominantly with phosphors and other flammable air-sensitive materials. This provided a solid groundwork in chemical materials and the knowledge to speak with familiarity to customers about their requirements. Chris used this background as a bridge to his next position within Inside Sales where he expanded his knowledge of Materion products and markets and further refined his customer relations skills.

With his latest position as Sales Specialist, Chris expects to build on this foundation. Part of his responsibilities will be to spend more face time with

Excerpt following is from the [NRC Guidance Document](#) to "Distribution of Source Material to Exempt Persons and to General Licensees and Revisions of General License Exemptions." [Continue this article about thorium fluoride replacements](#) and a summary of the new regulations...

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Materion Fluoride Materials

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on advanced chemical materials. Please review our latest data sheets on: [Thin Film Optical Coating Materials](#), [Fluorides](#), and [Oxides](#).

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customers to assist them with any issues but more importantly to offer help with new product development or guidance with selecting optimal materials for their application. He remarked: "I am really enjoying my new role as Specialist and extending my reach to help people directly. I hope to continue to grow in this position and in my knowledge of our customer needs."

[Read more about Chris...](#)

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