

Product Code / Order Code / Keywords

Search



0



STANFORD
ADVANCED MATERIALS

PRODUCT_
INDUSTRIES
APPLICATIONS
KNOWLEDGE BASE
SDS

- [Home](#)
- [Industry News](#)
- [An Introduction to 7 Types of Synthetic Garnet Materials](#)

An Introduction to 7 Types of Synthetic Garnet Materials

Garnets are a group of silicate minerals that have been used as gemstones and abrasives since the Bronze Age. The general chemical formula of garnet can be $A_3B_2(SiO_4)_3$, wherein A represents a divalent element, such as magnesium, iron, manganese, calcium, etc.; B is a trivalent element such as aluminum, chromium, iron, etc. The different garnet species pyro include pyrope ($Mg_3Al_2(SiO_4)_3$), amandine ($Fe_3Al_2(SiO_4)_3$), spessartine ($Mn_{2+3}Al_2(SiO_4)_3$), grossular ($Ca_3Al_2(SiO_4)_3$), uvarovite ($Ca_3Cr_2(SiO_4)_3$) and andradite ($Ca_3Fe_2(SiO_4)_3$). However, today we are not talking about these natural garnets, but synthetic garnets.

Synthetic garnet is also known as rare-earth garnet. The crystallographic structure of garnets has been expanded from the prototype to more advanced types. Similarly, we can

use a general chemical formula to describe it: $A_3B_2(CO_4)_3$. A & B represent the same divalent element and trivalent element as described before, while C not only represents silicon, but also a large number of other elements, such as germanium, gallium, aluminum, vanadium and iron.

In this article, you'll have a basic understanding of these 7 types of synthetic garnets: [terbium gallium garnet \(TGG\)](#), [terbium scandium aluminum garnet \(TSAG\)](#), [cerium doped lutetium aluminium garnet \(Ce:LuAG\)](#), [cerium doped gadolinium aluminium gallium garnet \(Ce:GAGG\)](#), [neodymium-doped yttrium aluminium garnet \(Nd:YAG\)](#), [chromium doped yttrium aluminium garnet \(Cr⁴⁺:YAG\)](#), and [gadolinium gallium garnet \(GGG\)](#).

Terbium Gallium Garnet (TGG)

Terbium gallium garnet (TGG) is a kind of synthetic garnet with the chemical composition of $Tb_3Ga_5O_{12}$. TGG has the advantage of large Verdet constant, low optical losses, high thermal conductivity and high laser damage threshold. It is widely used in optical isolators for laser systems, optical circulators for fiber optic systems, optical modulators, and current and magnetic field sensors. TGG single crystal is also the best magneto-optical material for making a Faraday rotator and isolator, with a suitable wavelength of 400-1100nm (excluding 470nm-500nm).



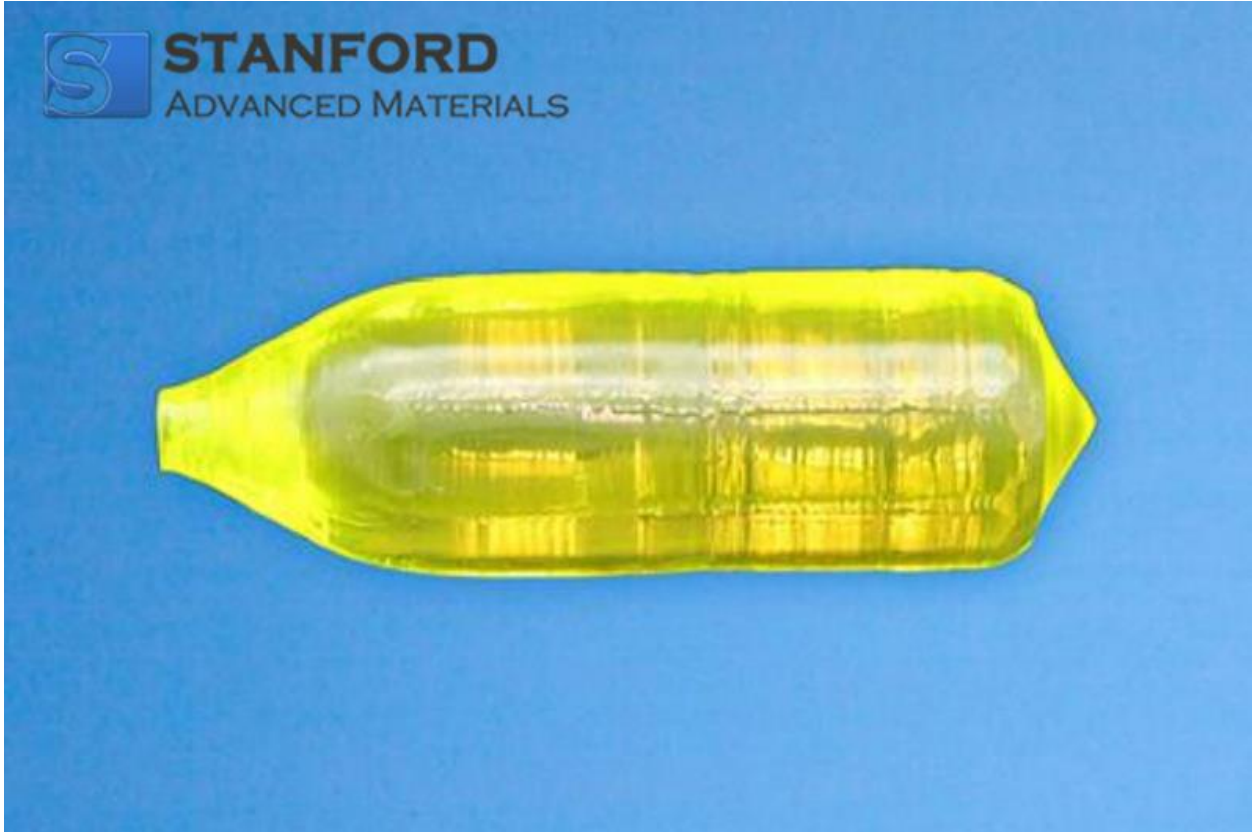
Terbium Scandium Aluminum Garnet (TSAG)

Terbium scandium aluminum garnet (TSAG) is a colorless and highly transparent synthetic garnet with the chemical composition of $Tb_3Sc_2Al_3O_{12}$. It has the advantages of high Verdet constant, and excellent thermal and mechanical properties. **TSAG** is a key isolator material for the next generation of fiber lasers, and is an ideal visible and infrared magnetic crystal.



Cerium doped Lutetium Aluminium Garnet (Ce:LuAG)

Cerium doped lutetium aluminium garnet (Ce:LuAG) is a relatively dense scintillator with the advantages of high density, fast decay time, non-hygroscopicity, and good mechanical and chemical performance. Ce:LuAG is also mechanically and chemically stable, and can be machined into a variety of shapes and sizes including prisms, spheres and thin plates. Ce:LuAG is suitable for thin imaging screens, medical scanning systems, high-energy particle accelerators & detectors, and laser & LED lighting.



Cerium doped Gadolinium Aluminium Gallium Garnet (Ce:GAGG)

Cerium doped gadolinium aluminium gallium garnet (Ce:GAGG) is a relatively new single crystal scintillator with high light yield, good energy resolution, high effective atomic number, fast scintillation response, chemical stability also ruggedness and capability of large crystal growth. Ce:GAGG crystal is a good choice for medical imaging techniques, such as X-ray imaging, computed tomography (CT), positron emission tomography (PET), and single photon emission computed tomography (SPECT).

Neodymium-doped Yttrium Aluminium Garnet (Nd:YAG)

Neodymium-doped yttrium aluminum garnet (Nd:YAG) is a synthetic crystal consisting of neodymium, yttrium aluminum, and oxygen with the chemical formula $\text{Nd:Y}_3\text{Al}_5\text{O}_{12}$. It is the earliest and most famous and most widely used laser crystal. Nd:YAG has relatively good optical absorption and conversion efficiency, low lasing threshold and good thermal dissipation for high power operation. It is a preferred laser working material that is widely used in medical and industrial lasers, such as laser marking machines, cutting machines, laser therapy instruments and beauty instruments.



Chromium doped Yttrium Aluminium Garnet (Cr⁴⁺:YAG)

Chromium doped yttrium aluminium garnet (Cr⁴⁺:YAG) is a crystal with the chemical formula of Cr⁴⁺:Y₃Al₅O₁₂. This crystal is chemically stable, UV resistant and durable. In addition, It can operate over a wide range of temperatures and conditions and is well suited for high-average power applications. Cr⁴⁺:YAG is an ideal material for passive Q-switching of Nd:YAG and other Nd and Yb-doped lasers in the wavelength range of 0.8 to 1.2 μm. It is also used for remote sensing, 3D scanning, and the Lidar system.



Gadolinium Gallium Garnet (GGG)

Gadolinium gallium garnet (GGG) is a crystalline garnet with the chemical formula $Gd_3Ga_5O_{12}$. GGG single crystal has good mechanical, thermal, and optical properties, such as low optical losses, high thermal conductivity and high laser damage threshold. It is a desired material for optical components and substrates. GGG single crystal substrate helps ensure the successful epitaxial growth of YIG & BIG films, which are core components of optical communication devices.



Stanford Advanced Materials (SAM) specialized in producing [optical crystal materials](#) for many applications & devices. Functional crystal materials mainly include magneto-optical crystals TGG terbium gallium garnet, TSAG; piezoelectric crystals LT (LiTaO₃) lithium tantalate, LN (LiNbO₃) lithium niobate, LGS lanthanum gallium silicate; scintillation crystals Ce: LUAG, Ce: GAGG; laser crystal Nd: YAG and single crystal epitaxial substrate crystals GGG, SGGG, lanthanum Aluminate LaAlO₃, etc. If you are interested in purchasing high purity crystal materials, feel free to [send an inquiry](#) to our Sales team.

[<< Previous](#)

[Military Tungsten Alloy Counterweight](#)

Next >>

[Additive Manufacturing \(AM\) & Powder Bed Fusion \(PBD\)](#)

About the author

Chin Trento

Chin Trento holds a bachelor's degree in applied chemistry from the University of Illinois. His educational background gives him a broad base from which to approach many topics. He has been working with writing advanced materials for over four years in Stanford Advanced Materials (SAM). His main purpose in writing these articles is to provide a free,

yet quality resource for readers. He welcomes feedback on typos, errors, or differences in opinion that readers come across.

REVIEWS

0 Thought On "An Introduction to 7 Types of Synthetic Garnet Materials"

LEAVE A REPLY

Your email address will not be published. Required fields are marked*

Comment

Name*

Email*

POST COMMENT

RECENT POSTS

[Tantalum or Platinum-Iridium: Marker Band Selection](#)[Ultimate Guide to Heat Resistant 3D Printing Materials: Top 10 Picks](#)[Precious vs. Refractory: An Exploration of Metal Crucibles](#)[Metric Prefixes: Conversions and Common Examples](#)[Thermal Expansion Coefficient: Metals, Alloys, and Common Materials](#)

CATEGORIES

[Most Popular](#)[Industry News](#)[Latest News](#)[New Products](#)[Exhibitions](#)[Case Studies](#)[SDS](#)[Company News](#)[Material Applications](#)[EV Batteries](#)[Elements Reference](#)

SUBSCRIBE OUR NEWSLETTER

*Name

*Email Address

I agree to receiving marketing and promotional materials.

*INDICATES REQUIRED FIELD

SUBSCRIBE

RELATED NEWS & ARTICLES

[MORE >>](#)



Precious vs. Refractory: An Exploration of Metal Crucibles

Metal crucibles stand as essential tools in a myriad of industrial and laboratory settings. These devices enhance processes, including precision craftsmanship and metallurgical endeavors. Within this realm, two distinct categories emerge, each tailored to

[READ MORE >](#)



Ultimate Guide to Heat Resistant 3D Printing Materials: Top 10 Picks

Choosing the right heat-resistant material for 3D printing depends on the specific requirements of your application, including temperature exposure, mechanical stresses, and environmental conditions.

[READ MORE >](#)



Tantalum or Platinum-Iridium: Marker Band Selection

Both Tantalum and Platinum-Iridium offer unique advantages. Careful consideration of factors such as biocompatibility, radiopacity, durability, and cost contribute to the successful integration of marker bands.

[READ MORE >](#)

Leave A Message

60FXE1

