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Study on Physical Properties and Chemical Composition of Some Myanmar Gems

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Abstract

Physical properties of some Myanmar gems were studied by using refractometer, dichroscope, polariscope, SG test, UV test and microscope. Then ,chemical composition were investigated by XRF – technique. After that, gem identification, evaluation, colour improvement were studied according to these physical properties and chemical composition.

Keywords: physical properties, chemical composition, XRF technique

Introduction

The study of gems through science which includes the formation of gem stone, properties, identification, grading and evaluation are called gemology. Myanmar gems can be divided into precious stone: diamond, ruby, sapphire, emerald, pearl, jade and other precious stone: spinel, peridot, quartz, tourmaline, aquamarine, topaz, zircon, amethyst, garnet, apatite, danburite, moonstone, iolite, opal, citrine, scapolite, amber ...etc.. A gem stone is a material that has intrinsic value and posses three fundamental quality (1) beauty (2)durability (3)rarity. Colour contributes to the beauty of gem, major factor for grading and evaluation and also an important properties for identification. Gems are some kind of m inerals and a most important characteristic of a mineral is the possession of structurally homogeneous solid of definite chemical composition formed by the inorganic process of nature. Most minerals occur as crystals and it must have systematic structure and it must be natural product. We can

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study the gems according to the chemical composition and physical properties such as crystal system, colour, refractive index, double refraction (Birefringence), doubling of back facet edges, dichroism and pleochroism, absorption spectrum, specific gravity, hardness, luster, dispersion or fire, fluorescence and phosphorescence.

Experimental

This research work was done at universitie's research centre and gem laboratory, geology department, YU. The physical properties of some Myanmar gem were studied by using refractometer, dichroscope, polariscope, chelsea colour filter, ultra-violet light, specific gravity test, hand len and microscope. Laboratory technique in gemology are x - ray method: radiographic technique, x- ray diffraction technique; spectrometric methods: infra-red spectrometer, uv- spectrometer; thermal conductivity meter; reflectance meter and scanning electron microscopy. The FTIR spectrophotometer test is a practical and effective method for detecting most type B jadeite which after acid bleaching are impregnated with resin to fill up cracks and to improve transparency. Accurate scientific tests will safeguard consumers as well as the industry. So far, spectrophotometry is the single most reliable non-destructive test for identifying, type B jadeite Then, the chemical composition of some Myanmar gems were. investigated by shimatsu ED700.

Result and discussion

We can identify gem quality according to physical properties: crystal system, colour, refractive index, double refraction, doubling of back facet edges, specific gravity, hardness, luster, dispersin, uv test and

inclusion. Inclusion are particle of solid, liquid or gaseous material enclosed within a gemstone. The nature of such inclusions provides a powerful clue to the origin of the stone, and enables natural stone to be distinguished from their synthetic counterparts.

Table 1. Physical properties of some Myanmar gems

Gem	Ruby	Sapphire	Spinel	Peridot	Jade
Crystal system	Trigonal	Trigonal	Cubic	Orthorhombic	Monoclinic
Colour	Red	Blue, Colourless	Red, Orange, Violet, etc	Yellow green	White, Green, Pink
RT	1.76-1.77	1.76-1.77	1.715	1.654-1.690	1.67
DR	0.008	0.008	-------	0.036	------
DBF	-------	--------	--------	strong	-------
SG	3.99	3.99	3.58-3.61	3.34	3.33
HN	9	9	8	6 1/2	6.5-7
Laster	Vitreous	Vitreous	Vitreous	Vitreous	Vitreous
Dispersion		0.018	0.020		-------
UV (long)	glow	Faint glow	Faint glow	glow	inert
Test (short)	inert	inert	inert	inert	inert

We can also identify roughly according to the major chemical composition.

Ruby and Sapphire - Al_2O_3 Peridot - $(Mg,Fe)_2SiO_4$

Spinel - $MgO.Al_2O_3$ Jadeite - $NaAl(Si_2O_6)$

Purest Al_2O_3 is colourless (white sapphire),with trace of Cr, colour char.ges to red, called Ruby. With trace of Fe and Ti, colour changes to blue, called Sapphire. The red colour Spinel contains higher content of Cr_2O_3. Colourless Spinel contains major amount of Al_2O_3 and MgO. The orange colour contains higher content of V_2O_5 and bluish gray to deep purplish b lue c olour s pinel c ontains h igher c ontent o f F e_2O_3.It w as also found that Zn rich sample becomes orange colour and Cr rich sample becomes red colour.

Table 2. Chemical composition of some Myanmar gems

Element%	Ruby (Mogok)	Ruby (Mirgshu)	Sapphire	Spinel	Peridot	Jade
Al_2O_3	**91.453**	**83.469**	**90.779**	**71.3**	-------	**25.529**
Fe_2O_3	1.222	0.242	4.682	1.21	**33.396**	0.821
SO_3	5.559	-------	3.849	2.549	-------	-------
SiO_2	------	12.461	------	-------	**36.912**	**54.216**
Cr_2O_3	0.819	0.976	------	0.947	-------	0.167
CaO	0.790	2.434	-------	-------	-------	1.319
SrO	0.150	-----	-------	-------	-------	------
TiO_2	-------	0.215	0.401	-------	--------	-------
ZrO_2	-------	--------	-------	0.137	---------	------
MgO	------	--------	-------	**10.32**	**27.039**	--------
ZrO	------	--------	-------	4.19	--------	--------
V_2O_5	------	0.169	-------	1.216	--------	--------
CaO_3	------	--------	-------	0.125	--------	--------
NiO	-----	--------	-------	-------	2.255	--------
MnO	------	--------	-------	-------	0.428	--------
Na_2O	-----	-------	------	-------	-------	**11.113**

Ultra-voilet test	**UV(long)**	**UV (short)**
Ruby (natural)	glow	inert
Ruby (synthetic)	glow	glow(10 sec)phosphorescence
Sapphire (natural)	glow	inert
Sapphire (synthetic)	glow	greenish white glow
Spinel (natural)	inert	inert
Spinel (synthetic)	glow	faintglow

Conclusion

The experimental results indicate that the physical properties and chemical composition are very useful to identify and evaluate the gems. It is found that with instrument test are very useful and without instrument test are also. Every gem has specific gravity and RI, so we can easily identify according to these value. The overwhelming presence of enhanced gems has been a major worry for the jewellery industry. Known as type B jadeite, enhanced jade looks, feels and reacts to various chemical and chemical test much like natural jadeite. Ironically, type b jadeite has created a saturation in which natural jadeite is mistaken as type B jadeite, making consumer more leery of buying jade. Accurate scientific test will safeguard consumer as well as the industry. X- ray is very useful in the testing of gems and its simulates. The use of direct radiography relies on the fact that different materials have varying degrees of transparency to x-ray. This assists comparison of diamond and its substitute; diamond are transparent to x- ray, stimulant are not. It is also useful for detecting glass fracture filling in gem. It is also used to examine the effect of diffraction of the ray from the atomic crystal structure planes of material. X- ray diffraction can be used to distinguish between natural and stimulants .X-ray are even more dangerous then ultraviolet light , and should never be used except qualified staff under laboratory condition. SEM uses an electron beam to scan the prepared surface of an object. Scattered electron reflections are detected at very high magnification. When you determine the gem stone, it is important to consider that whether the stone is natural

or synthetic or enchanced? Is the colour natural or not? Are there any noticeable inclusion? Then, how can it be used material science in physics ?For example, quartz can be used as oscillator and tourmaline can be used in electronic instrument due to its pyroelectric, i. e. develops opposite electric charges at the two end of the crystal when it is heated. This research work study the chemical composition by using XRF technique and physical properties; SG, HN, colour, luster, crystal system, RI, DBR, DBF, dispersion by using laboratory instruments. According to the experimental results, we can say, such laboratory equipment are very powerful to study the identification, evaluation, colour improvement and provides the increase of their value of some Myanmar gem stones.

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