



The Gem and Jewelry Institute of Thailand (Public Organization)

LAB UPDATE

SYNTHETIC RUBY FILLED IN MARBLE

By GIT-Gem Testing Laboratory

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INTRODUCTION

“Ruby-in-marble” is a mineral collector’s popular item that has been traded favorably in the mineral market. This type of specimens usually comes from Myanmar, Vietnam and Afghanistan where rubies appear embedded in the white marble host rocks. The market prices can vary depending on the number, size and quality of the ruby crystal(s) in the rocks. Recently, the GIT-GTL received a piece of this material submitted for identification, but the result has taken us by surprise.

SAMPLE AND PROCEDURES

This specimen has the weight of 1.18 kg and the dimension of approximately 12.5 x 10.7 x 6.3 cm (Figure 1). The piece was declared by the owner to be “a natural ruby-in-marble”. We firstly examined the sample visually by naked eyes and then by exposed to long-wave ultraviolet (LWUV) pen light. We could not measure refractive indices and pleochroism due to the limitation of specimen character. We further investigated the sample by using advanced equipment, namely, Renishaw inVia Raman micro-spectrometer with a green laser (532 nm excitation), Energy-dispersive X-ray fluorescence (EDXRF) spectroscopy Model Eagle III system and Softex SFX-100 X-radiography



Figure 1: Rough “Ruby-in-marble” specimen showing a dark red crystal in white marble submitted to GIT-GTL for testing. Photo by S. Promwongnan.

RESULTS AND DISCUSSION

Visual appearance

This sample is a medium crystalline homogeneously white marble block with a naturally weathered yellow-brown surface on one side, and saw-cut or freshly broken-off white surfaces on the other sides (Figures 1 and 2 left). The rock has a dark red transparent crystal having “unusually polished surfaces” exposed inside a hole on the saw cut surface (Figure 2 right). This highly unnatural characteristics on a first glance have cast many doubts about the origin of this red crystal. Other unusual aspects of this specimen are that the ruby has not shown crystal habits of natural origin, such as hexagonal crystal shape, basal/rhombohedral parting or step-like surface. At high magnification, there seems to have a small gap between the red crystal and white marble that contradicts to the fact that the ruby forming in a host rock must have their crystal surface in contact with marble host. Thus, our visual investigation points a preliminary conclusion that this sample could be a fake “natural-ruby-in-marble”. In order to prove our observation, we conducted further gemological testing by using both basic and advanced instruments.

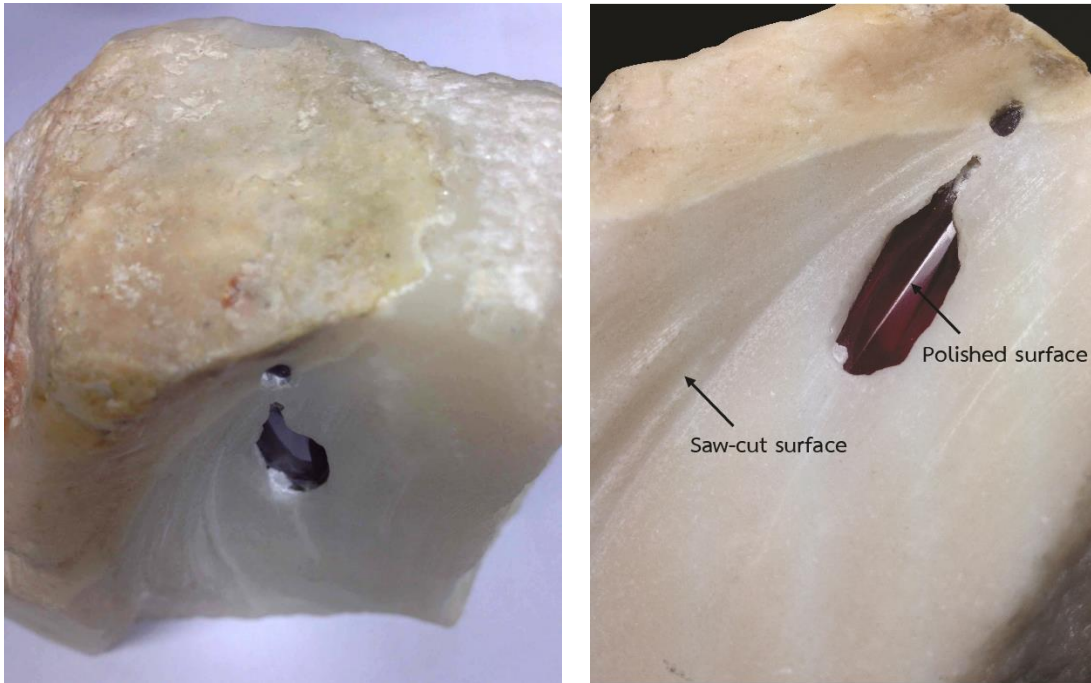


Figure 2: Left: the incline top view of the rock showing a naturally weathered yellow-brown surface. Right: a dark red transparent crystal that seems to have “peculiar polished surfaces” exposed inside a hole on the saw cut surface of the marble that is highly un-natural, approximate magnification 0.5X. Photo by M. Maneeakrajangsaeng

Gemological Properties

When the specimen was exposed to LWUV radiation, it showed fluorescent effect differently on different parts of the specimen. The dark red crystal showed strong red fluorescence typical of synthetic ruby while the marble body appeared chalky greenish blue fluorescence (Figure 3, left). A part of the weathered surface gave strong whitish greenish blue fluorescence (Figure 3 left, arrow) which may be due to the presence of some unusual trace elements coating on its surface. All fluorescence characteristics were compared with daylight appearance (Figure 3, right).

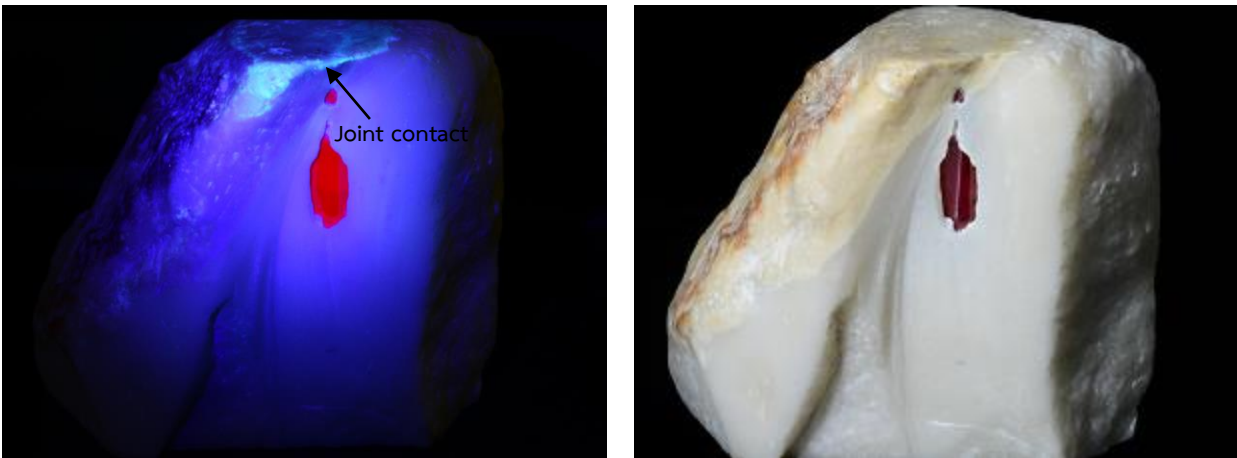


Figure 3: Left: Fluorescence image taken under LWUV pen light showing strong red fluorescence of the ruby crystal inside the hole in contrast to the chalky greenish blue fluorescence of marble host. Noted also the strong whitish greenish blue fluorescence of a part of the weathered surface (arrow). Right: image is captured under normal daylight for comparison. Photo by S. Promwongnan.

ADVANCED INSTRUMENT ANALYSIS

The Raman spectrum recorded from different spots of this sample proved that the white area is composed mainly of calcite and the dark red polished crystal is corundum (Figures 4 and 5).

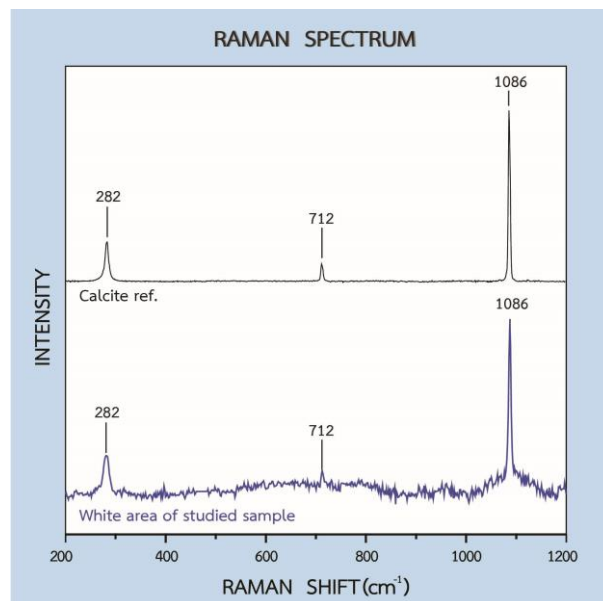


Figure 4: The white area shows the calcite's Raman peaks, at 282, 712 and 1086 cm^{-1} .

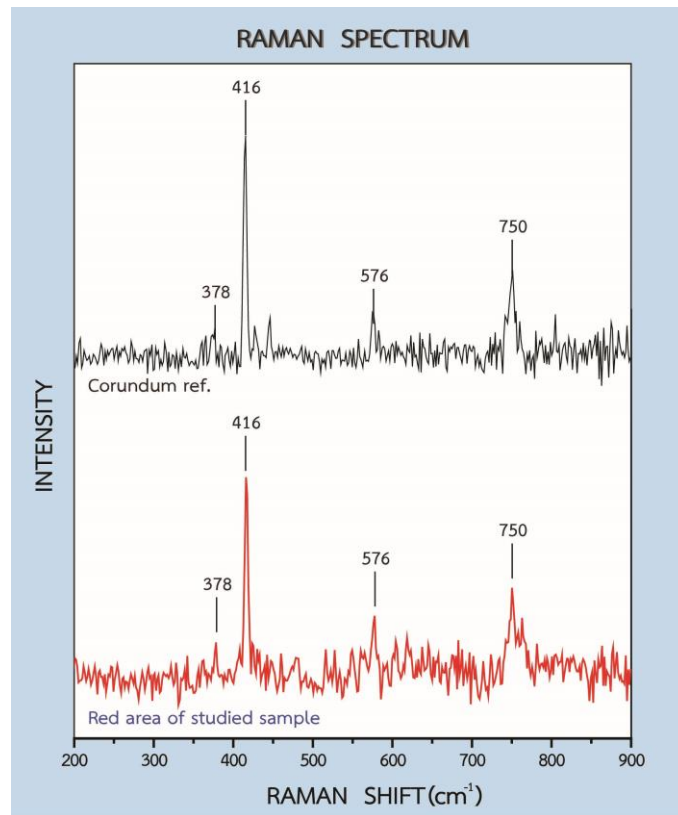


Figure 5: The Raman spectrum for the dark red area of the sample recorded peak at 378, 416, 576 and 750 cm^{-1} assigned to corundum.

Semi-quantitative chemical analysis of the dark red crystal indicated very low contents of Fe, Ti and Ga typically found in synthetic ruby with calcium contamination from a marble (see table 1).

Table 1: Trace element contents of the dark red crystal area of the sample obtained by EDXRF

Element Oxides (wt.%)	Al ₂ O ₃	CaO	TiO ₂	V ₂ O ₅	Cr ₂ O ₃	Fe ₂ O ₃	Ga ₂ O ₃
The dark red crystal area	97.20	1.98	0.01	0.10	0.68	0.02	BDL

The X-radiograph clearly revealed a window, a crystal and a drilled hole (Figure 6)

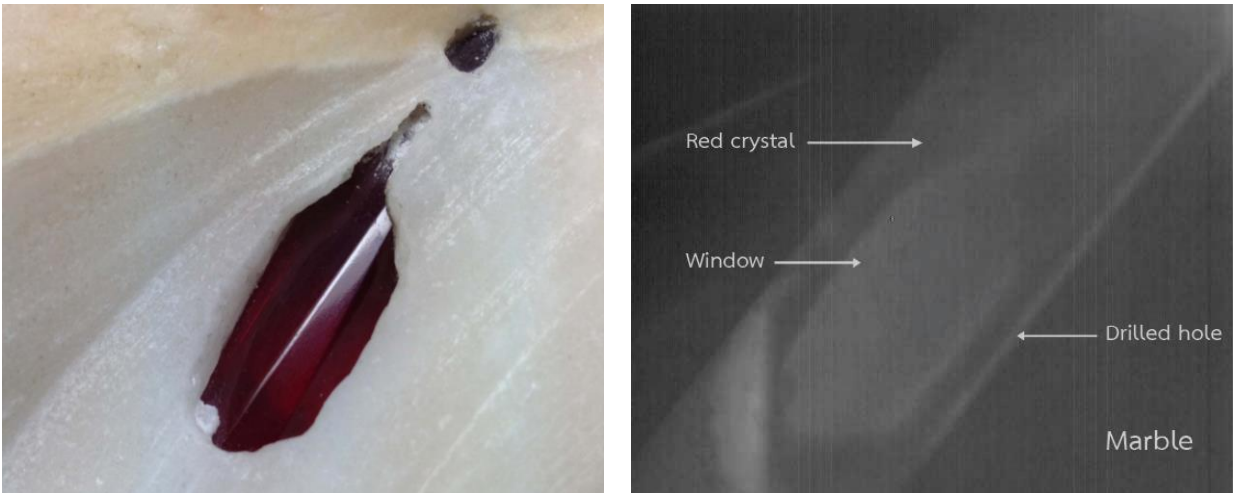


Figure 6: The X-radiograph images of this sample from a side view showing a window, a crystal and a drilled hole. Photos by M. Maneekrajangsaeng.

CONCLUSIONS

Based on the aforementioned evidence, we can conclude that this specimen is a “synthetic ruby filled in the marble” to imitate the natural-ruby-in-marble. This imitation product was probably done by drilling a hole into the saw-cut surface of white marble. Then, a polished rod of synthetic ruby was glued inside the hole by exposing polished faceted surfaces through the hole opening. This could make it, apparently for the un-trained eyes, look like a natural ruby crystal in marble host rock.

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