

**Title :** Effect of Low-Temperature Heat Treatment on the Color Enhancement and Inclusion Features of Myanmar Sapphire

**Author(s) :**

1. Kanitta Ganngandee
- 2.
- 3.

**Student ID :** 650510475

**Student ID :**

**Student ID :**

**Major :** Gemology

**Advisor(s) :**

1. Dr. Rattaphon Amphon
2. Associate Professor Dr. Apichet Boonsoong
- 3.

**Type of presentation\* (choose 1) :**

**Oral Presentation** (เฉพาะ ตัวแทนศ.ที่สาขาเลือกให้นำเสนอแบบบรรยาย)

**Poster** (กรณี นำเสนอผลงานปัญหาพิเศษ/การค้นคว้าอิสระ)

**Cooperative Education** (กรณี นำเสนอผลงานสหกิจศึกษา)

## ABSTRACT

Natural sapphires may sometimes appear overly dark blue due to excessive of  $\text{Fe}^{2+}\text{-Ti}^{4+}$  intervalence charge transfer (IVCT) process, which is the primary cause of blue coloration in sapphire. Therefore, heat treatment is commonly applied to reduce the intensity of this blue coloration, resulting in a brighter appearance. In addition, heat treatment aims to reduce the visibility of inclusions, improving the clarity of the gemstone. Traditionally, heat treatment of sapphire is performed at high temperatures (above  $1500^{\circ}\text{C}$ ). However, low-temperature heat treatment has recently gained popularity because it is more difficult to detect. This study investigated 29 sapphire samples from Myanmar. The samples were classified into dark blue and medium dark blue groups based on color tone. All samples were subjected to low-temperature heat treatment under oxidizing conditions at  $1100^{\circ}\text{C}$ . The results before and after treatment showed that all samples were inert under both short-wave and long-wave ultraviolet light. Most fissure and inclusions showed only slight changes after treatment. Most inclusion became fainter or partially dissolved, while surface-reaching fractures exhibited localized melting. Analysis UV-Visible-Near Infrared (UV-Vis-NIR) spectrophotometer indicated an increase in  $\text{Fe}^{3+}$  absorption peaks at 330, 377, 388, and 450 nm, while the  $\text{Fe}^{2+}/\text{Ti}^{4+}$  IVCT absorption band between 500 and 700 nm decreased. Furthermore, Fourier

\*Type of presentation must be matched with an option you choosing on student upload system.

\*\*The abstract can be more than one page and must be approved by project advisor before upload.

Transform Infrared (FTIR) spectroscopy identified changes in the hydroxyl group (-OH) peaks at approximately 3309, 3232, and 3185  $\text{cm}^{-1}$ . X-ray Absorption Near Edge Structure (XANES) analysis confirmed a significant oxidation state shift from  $\text{Fe}^{2+}$  to  $\text{Fe}^{3+}$ . Chemical composition analysis using scanning electron microscopy (SEM) showed that the Myanmar sapphires consist mainly of Al and O, with average contents ranging from 85.405-86.920 wt% and 11.015-13.386 wt%, respectively. Trace elements responsible for coloration include Fe, ranging from 0.809-1.366 wt%, and Ti, ranging from 0.114-0.240 wt%. Overall, the results indicate that low-temperature heat treatment under oxidizing conditions can reduce the intensity of blue color caused by the  $\text{Fe}^{2+}$ - $\text{Ti}^{4+}$  IVCT process and improve gemstone clarity. These changes can be detected through variations in certain inclusions as well as FTIR and XANES analytical results.

*\*Type of presentation must be matched with an option you choosing on student upload system.*

*\*\*The abstract can be more than one page and must be approved by project advisor before upload.*