Characteristics of Commercial Grade Blue Sapphire Enhanced by Heat & Pressure

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In this study, 18 commercial grade blue sapphire samples (1.33–4.99 ct.) treated with heat and pressure were purchased directly from a known producer. The trader also informed us that starting materials being used for his treatment in Korea were selected from an unsuccessful batch of normally heated sapphire samples from Sri Lanka. Their characteristics are reported and compared with data from previous studies[1-5].

The basic gem properties of those stones fall in the range of a normal corundum (S.G. 3.951-3.978, RI 1.760-1.770). Their internal features are altered or melted solid inclusions ("snow ball"), altered healed-fissures with secondary fingerprints, tension disc, a dotted pattern due to the dissolution of rutile silk. These features are mostly overlapping with those found in the traditionally heated stones. Nonetheless, their reaction to standard UV light can give us the first hint. As most study stones are inert to both LWUV and SWUV (except one showing very weak chalky blue under SWUV) in contrast to a chalky blue fluorescence along growth zones under SWUV commonly seen in a normally heated blue sapphire from Sri Lanka. Furthermore, a noticeably slightly healed border of the clear and flattened tension cracks as well as the presence of black graphite residue in surface-reaching cavities or fractures (as confirmed by Laser Raman Spectroscopy) are also the good evidences to indicate the treatment with heat-plus-pressure.

The chemical data analyzed by EDXRF gave relatively low iron content (0.04-0.21 %wt. Fe_2O_3) which are consistent with our database of the stones originated from Sri Lanka. The UV-Vis-NIR spectra revealed that the cause-of-color is mainly due to the Fe-Ti Inter-Valence-Charge-Transfer mechanism like those of the blue sapphires originated from metamorphic origin. As also previously reported, the Mid-InfraRed spectra obtained by FTIR spectrometer do show quite a unique strong OH-related absorption bands and small shoulders or peaks that have never been reported before in traditionally heated blue sapphires. However, four main IR spectral patterns were observed from those stones (Figure 1). The patterns (b), (c) and (d) have never been reported in the previous studies[1-5] before and can be used as the key identification criteria for a heat-plus-pressure-treated stone as well. Furthermore, by simply re-heating three selected stones from those 18 samples at 1500°C for 4 hrs. in an oxidation condition, the strong OH-related absorption bands and small shoulders or peaks indicative of heat-plus-pressure treatment disappear completely, and the stone blue colors turn paler or colorless.

In conclusion, the identification of a heat-plus-pressure-treated stone may pose some uncertainty by using standard gemological methods alone. However, with additional advanced analyses, especially the FTIR spectrometer, it can positively help identifying the treatment.

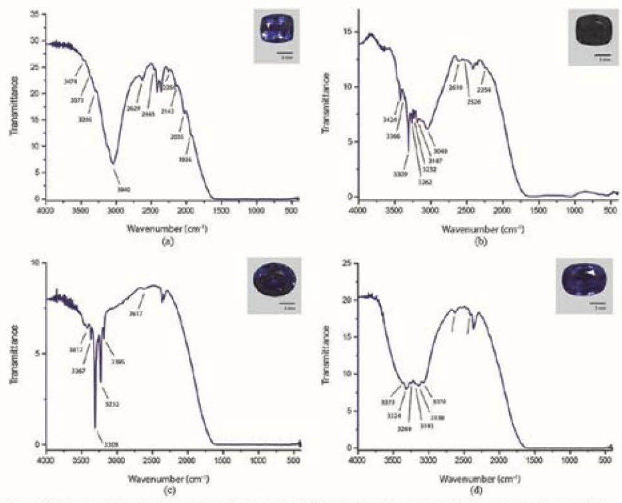

Figure 1 (a) A strong broad absorption band and small shoulders in range of 2700–3500 cm^{-1} with a maximum at 3040 cm^{-1} due to hydroxyl group (-OH).
(b) The strong broad absorption band and small shoulders between 2700-3500 cm^{-1} with a maximum at 3048 cm^{-1} of the hydroxyl group (-OH) together with strong sharp peaks at 3424, 3366, 3309 (strongest), 3262, 3232, 3187 cm^{-1}.
(c) The weak broad absorption band between 2700-3500 cm^{-1} of the hydroxyl group (-OH) together with strong sharp peaks at 3417, 3367, 3309 (strongest), 3232 (very strong), 3185 cm^{-1}.
(d) A very strong broad absorption band and small peaks between 2700-3500 cm^{-1}.

References

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