Color measurement of yellow sapphire by UV-Vis reflectance spectroscopy

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Yellow sapphire is a gemstone variety of corundum (Al_2O_3). The yellow color is commonly caused by Fe^{3+} impurity substituting for Al^{3+} in the Al_2O_3 structure. The depth of yellow color is linked to Fe^{3+} concentration. The higher content of Fe^{3+} produces a deeper yellow color. The quantitative relationship between color and the chemistry of natural corundum has been comprehensively studied [1]. However, some chromophores are low content of the impurity such as Be^{2+} in cooperating with low content of Fe^{3+} to produce the yellow color in yellow sapphires [2]. It is difficult to differentiate between the natural yellow sapphire caused by high Fe^{3+} content and the beryllium-treated yellow sapphire by naked eyes. Some advanced techniques to identify the Be heat-treated yellow sapphire have been practiced such as laser ablation inductively coupled plasma mass spectrometry (LA-ICP-MS), secondary ion mass spectrometry (SIMS) and laser-induced breakdown spectroscopy (LIBS). We measured the colors of natural and beryllium-treated yellow sapphires by UV-Vis reflectance spectroscopy. The concentration of impurities in the sapphire samples was measured by the LA-ICP-MS technique. To compare the yellow colors of CIELch, we found that the hue values of the beryllium-treated yellow sapphires were higher than the natural yellow sapphires.

Key words: Corundum, Natural yellow sapphire, Beryllium-treated yellow sapphire, Color measurement

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