QUALITATIVE METHOD FOR THE IDENTIFICATION OF SYNTHETIC AND NATURAL CORUNDUM: A STUDY USING XRD ANALYSIS

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Differentiation of synthetic and natural gemstones is a major concern for gem dealers and major jewellery importers. Natural corundum is a precious stone and, one of the most important exports of Sri Lanka. Corundum ($\alpha - Al_2O_3$) is known by different names depending on the colour it exhibits which in turn depends on the impurities that are present. The colour depends on the valence state of the impurity element present in corundum such as Cr^{3+} in ruby, Fe^{3+} in yellow sapphire and Fe-Ti complex in blue sapphire. There have been a number of incidences of synthetically grown corundum available in the market which cannot easily be differentiated with natural corundum with normal routine tests. Present study deals with the X ray powder diffraction results on different colours of natural and synthetic gem quality corundum and gives evidence of an external morphology and internal growth features that reflect their formation conditions, especially disorder brought about by such synthetic treatments. This can be effectively used for diagnostic purposes for detecting the synthetic stones.

Four (04) sets of corundum samples from different origins, both natural and synthetic have been analysed at the Industrial Technology Institute (ITI) for X ray powder diffraction (XRD). The characteristic set of d-spacing generated in a typical X-ray scan provides a unique "fingerprint" of the mineral or minerals present in the sample. The positions and the intensities of the peaks are used for identifying the underlying structure (or phase) of the material. The XRD results of both natural and synthetic corundum samples were found to be consistent with the standard international reference of corundum. Broadening of the peak was measured by calculating the Full Width at Half Maximum (FWHM) of the peak. Then, a graph was drawn as 2θ vs FWHM to find the behaviour of the broadening of the peaks. According to comparison of 4 sets of different colours of corundum, it was observed that shifting of XRD peaks of synthetic corundum are considerably high and high strain could be seen in synthetic corundum than that of natural variety.

The outcome obtained in this study from power XRD techniques could be effectively used to identify natural and synthetic gemstones using single-crystal X-ray diffraction with some modifications of the experimental setup.