Detail Investigation on Gamma Ray Irradiated Sri Lankan Yellow Sapphire

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The intensity of colour of yellow sapphires play a key role in estimating its value. Therefore, different treatment techniques are practiced to improve the yellow colour of sapphires. Among them heat treatment and gamma ray irradiation are the main techniques performed in Sri Lanka. However, scientific studies on gamma ray irradiated yellow sapphire is limited. Thus, in this research, spectroscopic investigation was carried out on irradiated Sri Lankan yellow sapphires. Twenty pale yellow sapphire samples were collected from Ratnapura area and 10 samples were exposed to gamma irradiation. Secondary radioactivity of the irradiated samples was tested using Digital Geiger Muller Counter. Colour stability test was carried out by exposing them to direct sunlight and shortwave ultraviolet light. Colour changes were evaluated using GIA® Colour grading tool and spectroscopic tests of UV-visible, Raman and FTIR were also performed. Results of radioactivity test showed that the radiation levels to be 19.25 CPM (counts per mints) for natural and 19.35 CPM for irradiated samples within 20 min and these levels are not hazardous to humans. However, the irradiation has improved the yellow colour. The colour developed due to gamma ray irradiation was stable under the UV light but, it turned into its original colour under the sunlight within 30 min. The UV-visible and FTIR spectrums of irradiated and control samples showed typical absorption patterns for natural yellow sapphires. Raman spectrums of control and irradiated samples also showed typical absorption spectra corresponding to Al-O. The intensities of all peaks (410, 895 and 1040 cm^{-1}) are comparatively higher in irradiated samples and the irradiated samples showed new peaks in 380 and 640 cm^{-1}. This may possibly be due to slight deformation of the lattice when exposed to gamma irradiation. In conclusion, the irradiated yellow sapphires do not emit harmful radiation and the colour developed is not stable.

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