Chemical Fingerprinting as a Tool for the Identification of Synthetic Gemstones

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Chemical fingerprinting (the characterisation of mineral specimen and synthetic/artificial crystals by their chemistry) has become an important tool in gemmology for the identification and characterisation of synthetic gemstones and their separation from natural gems.

The most important chemical criteria for the separation of natural and synthetic rubies and sapphires are the differences in the element contents Ga, Ti, and V. Noticeable low concentrations of Ga and Ti (normally <0.05 wt% Ga_2O_3 and TiO_2) are detected in most synthetic gemstones produced by different growth methods and manufacturers. Exceptions are, for example, the Greek synthetic Douros-rubies, which may show Ga contents even higher than those normally observed in natural rubies (up to 0.12 wt% Ga_2O_3), or synthetic Kashan rubies with TiO_2 contents up to 0.26 wt%).

Synthetic emeralds have very low Na_2O and MgO concentrations when compared to their natural counterparts (in general below 0.1 wt%). Synthetic emeralds grown by the hydrothermal or flux method may, however, contain elements, which are not found in adequate concentrations in natural gemstones (e.g. Ni, Cu, Cl). In flux-grown synthetic emeralds, traces of flux-related elements may be detected (e.g. Mo, Pb).

Synthetic alexandrites distinguish themselves, in general, because of their low Ga_2O_3 and SnO content (mostly <0.01 wt%). On the other hand, certain synthetic alexandrites produced in Russia may have high germanium contents (up to approx. 3 wt% GeO), together with elevated Ga and Sn.