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Gemstone Analysis by FT-IR: Identifying Treated Jades

Michael Bradley

Thermo Electron Corporation

FT-IR provides a rapid and definitive tool for discrimination of "A" and "B" jade. The inexpensive Nicolet™ 380 FT-IR spectrometer from Thermo Electron positions this method very well for use even in small facilities.

The key to the value of gemstones lies in their beauty. The obvious problem is that beauty can be enhanced by non-natural methods. When disclosed, this is not illegal; however, fraud is a concern.

There are three classes of jadeite jade commonly available.¹ "A" grade jade is natural jadeite, "B" jade is treated as discussed below, and "C" grade material is artificially color-enhanced. "C" jade is fairly easy to spot, but "B" materials are not.

"B" jade starts as raw jadeite with stains (1). The jade is soaked in acid to remove the stains. This weakens the stone by leaching out structural materials. The pores generated are filled with wax or epoxy resin, whose index of refraction closely matches jade. Besides potential fraud, this treatment may cause skin burns from residual acid, and discoloration of the epoxy resin can occur.

The refractive index of "B" material is correct for jadeite, and UV spectroscopy is not sufficiently diagnostic. Microscopy may not show enough detail to identify the treatment. So "B" material may pass as "A" jade.

Fourier Transform infrared (FT-IR) easily discriminates "A" and "B" jade. The analysis takes only a few seconds, and the procedure is unambiguous.

Experimental

A Nicolet™ 380 FT-IR spectrometer from Thermo Electron can be used in the analysis. Samples of "A" and "B" jadeite jade are mounted using "blue-tac," although care must be taken to prevent contamination of the jade. A 4X beam condenser was used here, but this is not essential.

The data were collected using Thermo's OMNIC™ software, and 64 scans at 4 cm⁻¹ resolution. Signals below 2300 cm⁻¹ were obscured, but the critical range between 2600 and 3800 cm⁻¹ is clear.

Results

Spectra from "A" and "B" jade are shown. The "B" jade has a large peak located in the aliphatic hydrocarbon region. The differences are immediately obvious. Amazingly, the limited open spectral region is sufficiently diagnostic to identify the class of material used. Searching against Thermo's FT-IR libraries, the top hits are all epoxy resins.

The FT-IR analysis of gemstones is simple and non-destructive.

OMNIC allows SOPs to be constructed, to allow operators unfamiliar with FT-IR to use the method. The speed of analysis could allow incorporation into bulk testing facilities, and the inexpensive nature of the 380 would allow even small retailers to use it. The analysis could be extended using TQ Analyst™, Thermo's chemometrics program, to include quality checks and identification of known treatments.

Conclusions

Reference 1 states "B jade is here to stay." This is not inherently illegal, unless the treatment is not documented. Most, if not all, precious stones are susceptible to enhancement. FT-IR is an effective tool in uncovering treated stones, which should assist in enforcing disclosure.

Acknowledgement

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References

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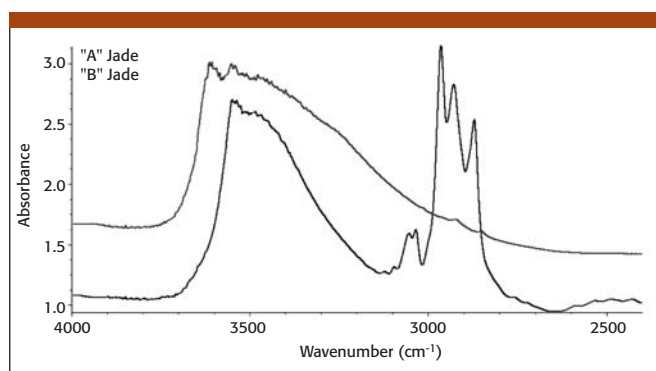


Figure 1. The strong hydrocarbon peak of the treated "B" jade is clearly diagnostic.

Thermo Electron Corporation

5225 Verona Road, Madison, WI 53711
Tel. (800) 532-4752, Fax (608) 273-5046
analyze@thermo.com, www.thermo.com