Nicolet

INSTRUMENTS OF DISCOVERY

Field Service Technical Bulletin

Information

Title: Spectrum Artifacts In Single Beam Energy Profiles

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Special tools and materials: NA

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Since the beginning of Magna with desiccated option and later the Impact with KBr lenses, there have been questions about absorption bands which show up in the single beams. This bulletin is intended to explain the origin of these bands which occur on our KBr optics parts. These bands show up the most with desiccated option windows and moisture protective coated KBr lenses. They can also show up on beamsplitters, detector windows, and other optics parts.

There are 3 basic sources for the materials causing the absorption bands:

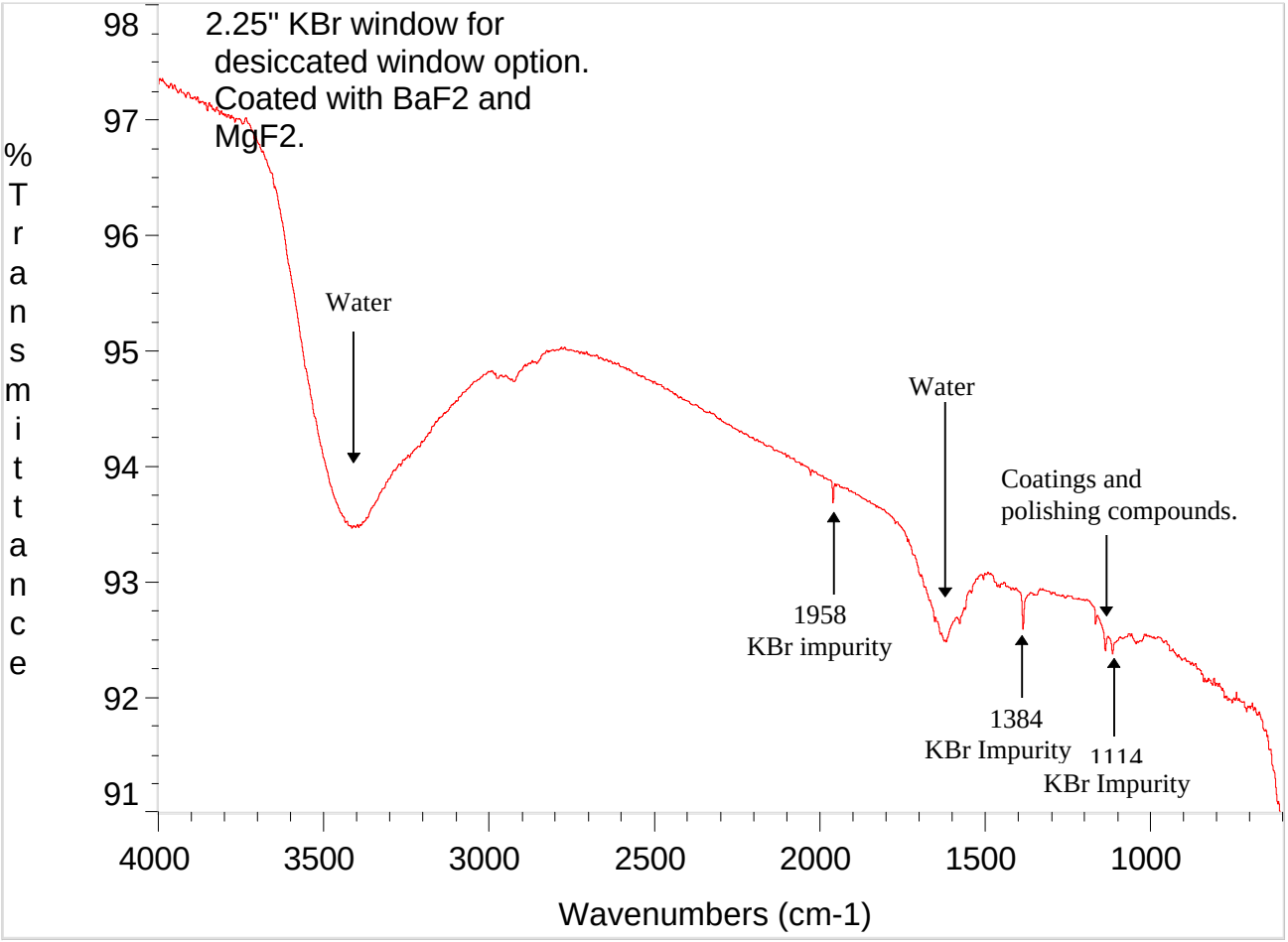
1. Polishing compounds. The materials used to polish KBr sometimes get “trapped” in the KBr crystal or bonded to the surface. The absorption bands are usually located around 2967, 2925, & 2850 wavenumbers. Sometimes additional bands show up in the 1500 - 1600 and 1100 wavenumber area.
2. Material reacting with the surface or becoming bonded to the surface. This usually occurs from fumes in the air. Cleaning solvents, adhesives, stripcoat, and oil mists have been know to bond to our optic crystals. These bands usually show up around the same areas as the polishing compounds.

Also, water vapor can be absorbed into the KBr and into the protective coatings. This causes a wide absorption band usually centered around 3400 and 1640 wavenumbers.

3. Impurities in the KBr. This is due to the manufacturing process for KBr. Since these are part of the whole crystal structure, the material we normally use causes sharp bands at 1959, 1384, & 1114 wavenumbers. Because the bands are sharp, the amplitude of these bands will vary depending on the resolution of the measurement.

Also note that there is a feature in the middle of the water bands at 3740 wavenumbers. This is due to an emission characteristic of the source. It is slightly temperature dependent and sometimes shows up in sample measurements when there is a long time between the background and the sample.

Although we try to minimize these features, all the above features are normally stable and ratio out in normal sample measurements.

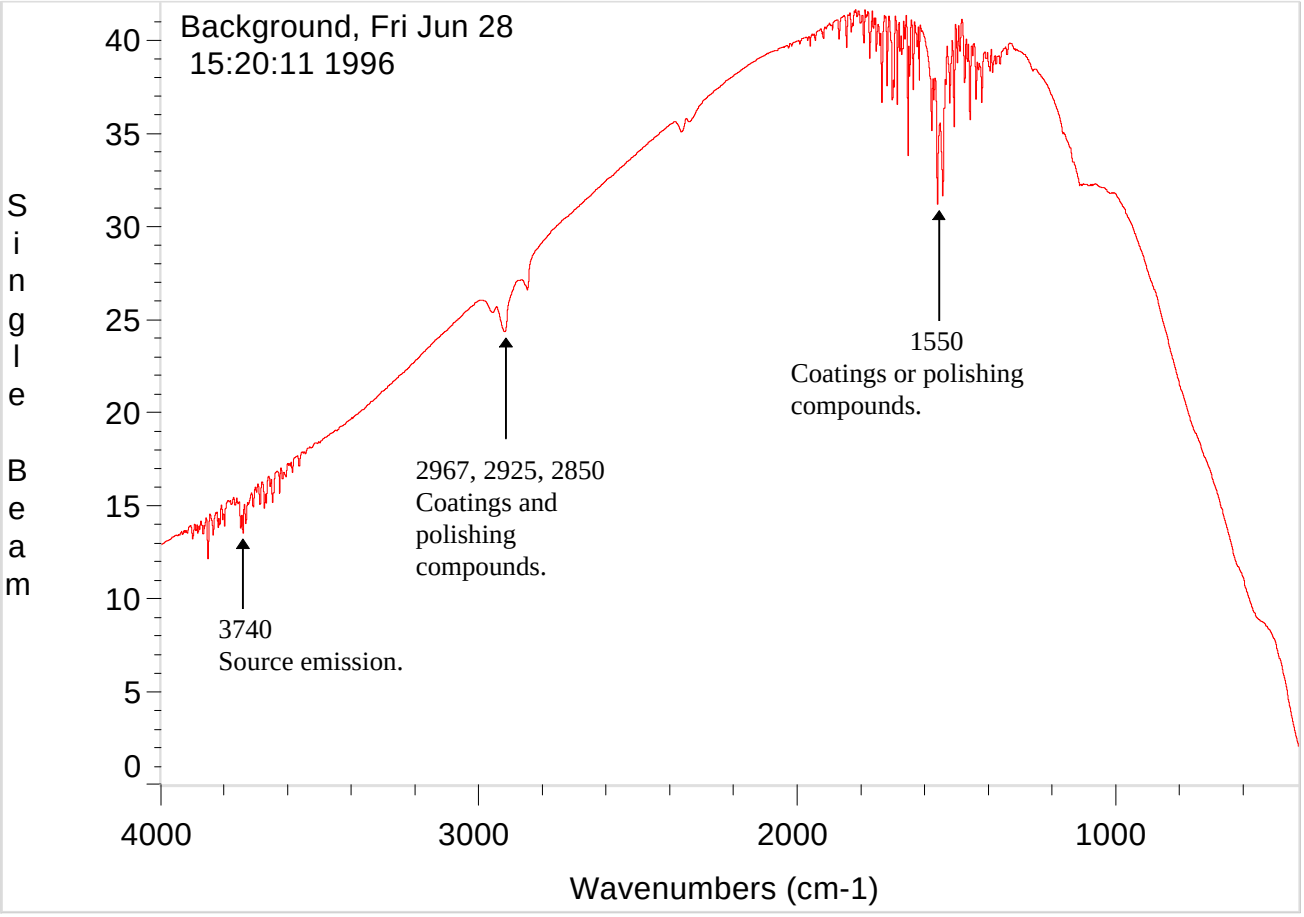


The plot above is a transmission spectrum of a coated KBr window. This example shows severe degradation from water absorption. This measurement was taken from a 2.25” dia. window used for the Magna desiccated option. This plot shows the wide areas of water absorption into the KBr and the coatings. Also, this shows the impurity bands in the KBr crystal.

Also note that there are some small features at 2967, 2925, & 2850 wavenumbers. These are due to the polishing material which is bonded to the surface.

Be aware that fumes, oil mists, and adhesive vapors can all carry materials which can adhere to optics surfaces. Also, these materials can become chemically “active” and form compounds which become bonded to the surface.

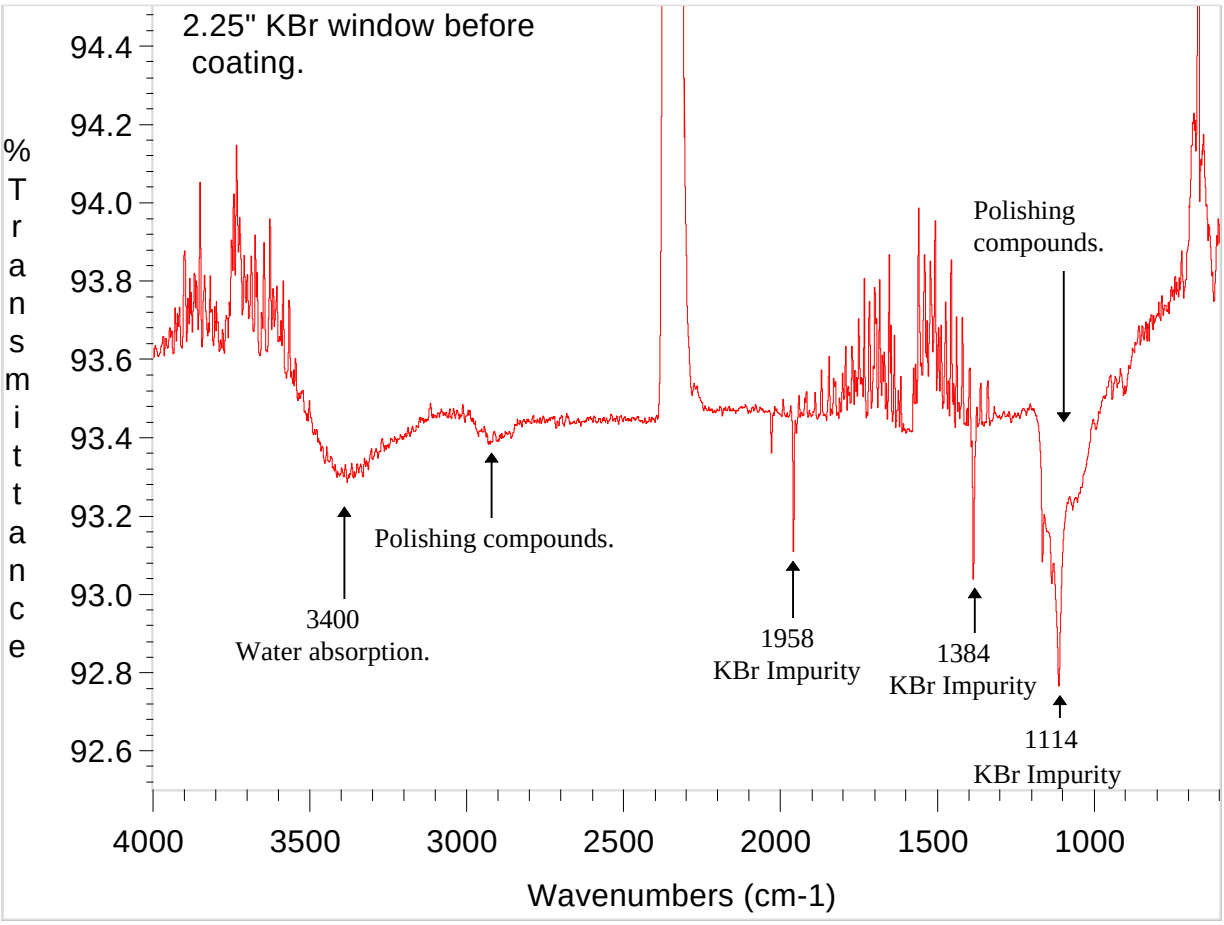
* Water Absorption:	Wide bands centered around 3400 and 1640 wavenumbers.
* KBr Impurities:	Sharp bands at 1958, 1384, & 1114 wavenumbers. Note that the amplitude of these bands will change depending on the resolution of the measurement.
* Polishing Compounds:	Usually 3 bands at 2967, 2925, & 2850 wavenumbers. These are the most common bands that appear in single beams. Other bands sometimes occur centered around 1100 and 1550 wavenumbers.



This is a typical single beam from an Impact with TGS detector. Because of the polishing compounds and the moisture protective coatings on the lenses, spectrum features show up in the following areas:

* 2967, 2925, 2850, & 1550 wavenumbers: These are features from polishing compounds and moisture protective coatings.
* 3740 wavenumbers: This feature is due to the source emission characteristics and varies from source to source.
* Components from the plots on pages 2 & 4 may also be visible in the single beam spectrum of an Impact.

<u>Note that the spectrum examples in the Impact Owners Manual and the examples in the Omnic Users Guide may be different. The examples in the Omnic Users Guide are taken from measurements in Magna series spectrometers without “desiccated window option” and are therefore “clean”. Because of the coated KBr lenses, the Impact single beams will show more “features” than the Magna series single beams.</u>



The plot above is a transmission spectrum of a 2.25” dia. KBr window before coating for moisture protection. This piece of KBr has more impurities than the coated KBr window example on page 2. There is also a wide band around 3400 wavenumbers from water absorption onto the KBr.

* 3400 wavenumbers: Water absorption.

* 2967, 2925, & 2850 wavenumbers: In this example, small bands from polishing compounds.

* 1958, 1384, & 1114 wavenumbers: Bands from impurities in the KBr crystal.

* 1100 wavenumbers: Wide area of bands from polishing compounds.