Mount for a Large Potassium Bromide Beamsplitter in a Cryogenic, Space Application

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This paper describes an approach to mounting Potassium Bromide (KBr) optical elements that are expected to survive launch vibrations and a cryogenic environment. These KBr optics constitute the beamsplitter and compensator for a high-resolution, infrared Fourier transform spectrometer (FTS). This spectrometer is part of the Tropospheric Emissions Spectrometer (TES) instrument which will operate in the 3.2 to15.4 μm spectral range. TES is part of NASA's Earth Observing System (EOS) initiative to better understand our Earth's environment. TES is designed to obtain data on tropospheric ozone and other gas molecules that lead to ozone formation. These data will be used to create a three-dimensional model describing the global distribution of these gases to better understand global warming and ozone depletion. The TES interferometer is a Connes type with input and output beams separated by 108 mm resulting in two distinct clear apertures on the beamsplitter element.

KBr has a low elastic limit, a high coefficient of thermal expansion, a high water solubility and is susceptible to degradation from humidity. These characteristics make it a rather difficult optical material to mount and protect from environments typically resisted by glass optics. Various approaches have been considered by others to address these difficulties. The design described here uses a 6:1 aspect ratio of diameter to thickness resulting in a rather massive element. Due to instrument mass and volume constraints in the interferometer, a pseudo-rectangular shape for the optical elements was devised and a graphite/cyanate ester support structure was designed to minimize the mass of the entire beamsplitter assembly.

Vibration isolation of the optical elements was provided by RTV silicone pads, which were also designed to meet thermal stress concerns for the 180K operating environment. Both structural and thermal analyses were performed to verify the initial design. Further vibration and thermal testing of development units is expected to uncover any unforeseen problems and to verify compliance in areas of concern.

This paper addresses RTV silicone material properties required to properly support the KBr optics and the results of preliminary thermal and structural models. Testing of development units is expected to be complete in late February '98, and results will be available at that time.