## 概要

Infrared observations allow us to observe low-temperature interstellar dust, the centers of galaxies, and the birth sites of stars surrounded by dense gas, which cannot be captured by ultraviolet or visible light. In order to make observations using infrared light with high sensitivity, it is important to develop infrared space telescopes that can perform astronomical observations in space. However, there are many limitations to using infrared light in space for high-sensitivity observations. One of these limitations is that infrared space telescopes are too large.

Conventionally, refractive optics is difficult to use in the mid- and far-infrared wavelengths because of the lack of knowledge of optical materials that can be used. Therefore, reflective optics were used for astronomical telescopes, which is the reason for their large size. To overcome this difficulty, it is necessary to realize refractive optical elements such as lenses, prisms, and grisms that can be placed in the optical path. KRS-5, which is often used as a prism material at mid- and far-infrared wavelengths, is a mixture of thallium bromide and thallium iodide. Its crystals are relatively soft and brittle. Thallium is toxic, and inhalation of the powder produced when polishing the surface of the prism can cause poisoning. Therefore, it is considered highly dangerous and difficult to process. Until now, the size of prisms made with KRS-5 has been at least a few centimeters. However, in recent years, there has been a tendency for these prisms to become larger. Therefore, the realization of refractive optics requires an accurate understanding of the optical performance of the prism.

The High Dispersion Spectrograph is an instrument that can observe celestial objects with high sensitivity. The wavelength resolution of the spectrograph on TMT, a ground-based optical-infrared large astronomical telescope currently under construction, is $\lambda/\Delta\lambda$=100,000. However, NASA's JWST, a large space telescope launched last December, has a wavelength resolution of $\lambda/\Delta\lambda = 3{,}000$. Therefore, the realization of high-dispersion spectroscopic observations in space has been delayed.

The immersion grating (IG) is one of the spectroscopic elements that are attracting attention for overcoming this problem and enabling high-dispersion spectroscopic observations in space. Compared to the gratings used in ordinary high-dispersion spectroscopic instruments, IGs can reduce their size by a factor of n (or 1/n3 in volume) by passing light through a medium with a high refractive index n. Therefore, they can reduce the overall size of the instrument. Therefore, it can reduce the overall size and weight of the device.

According to the previous research of our research group, CdZnTe, which is transparent in the infrared region (wavelength: 8-20 m), was selected as the material for the mid-infrared IG. However, its performance as a spectroscopic device has not yet been demonstrated.

Our future goal is to accurately measure the optical performance of the KRS-5 prism and CdZnTe in the mid-infrared at cryogenic temperatures. Specifically, we want to confirm the uniformity of the refractive index in the plane of the KRS-5 prism and determine the refractive index of CdZnTe in the order of 10-4.

Since conventional refractive index measurement devices do not allow us to measure the refractive index in the cryogenic and mid-infrared regions, we need to construct our own refractive index measurement

device. As a preliminary step, we are currently building a device that can measure the refractive index in visible light at room temperature. Since CdZnTe cannot be measured in this condition, we will focus on KRS-5 only. By measuring the KRS-5 prism, we aim to identify the technical issues of this device, its error factors, and evaluation.

In this measurement, the refractive indices of the plastic prism and the KRS-5 prism were measured. They were $1.488 \pm 0.14$ and $2.579 \pm 1.12$, respectively. It was found that they still did not meet the required performance of SMI.

Therefore, as an interim report of the research in the doctoral course, this report describes the first step of the development, the measurement of the refractive index of KRS-5 at room temperature and visible light, and the identification of technical issues and their error factors and evaluation.