Lithium Niobate Single Crystal: revisiting the properties for application in Galileo Solar Space Telescope

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Solar radiation is mainly modulated by the evolution of the structure of the Sun's magnetic field. Although systematic observations have been carried out, there are still open scientific questions. Imaging spectropolarimetry is a powerful technique for remote sensing of the solar magnetic field. Current instruments have inherent limitations requiring trade-offs between spectro-polarimetric sensitivity and cadence [1]. The Galileo Solar Space Telescope (GSST) aims to provide accurate measurements of the magnetic field in the photosphere and upper layers of the solar atmosphere.

Lithium niobate ($LiNbO_3$, LN) is a known functional material that has applications in many kinds of devices due to its properties. In Solar physics, the LN wafers have been successfully qualified in crystal-based Fabry–Perot interferometers in balloons [2], or space missions [3]. Galileo Solar Space Telescope (GSST) group has proposed a solution based on the Volume Holographic Gratings (VHG) to obtain multiple wavelengths simultaneously. We reviewed the LN properties, particularly for VHG on space spectrometry applications; the discussion is focused on Commercial-Off-The-Shelf (COTS) LN and perspectives of possible advantages of custom LN.

We present the first results on the growth of undoped and doped LN single-crystal fibers by micro-pulling down (μ-PD) technique, which is a fast way to grow single crystals for characterization. We will show the crystal characterization using Raman micro-spectroscopy, optical microscopy, and scanning electron microscope to investigate the pull parameters and crystal quality. To achieve the strict requirements of solar observation instruments, tailoring the key lithium niobate properties may be crucial to attaining appropriate volume holographic gratings to be used as filtergraphs in a future space mission. Further, it will also be shown a new perspective application on bolometers for Solar absolute radiometers.

References

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