A CRITERION FOR USING SPECTRAL INTERFEROMETRY IN FAR INFRARED DISPERSION MEASUREMENTS

H. Delbarre, C. Przygodzki, M. Tassou, and D. Boucher

Laboratoire de Physico-Chimie de l'Atmosphère
Université du Littoral
M.R.E.I.D. 145, avenue Maurice Schumann
59140 Dunkerque, France
E-mail: hdelbarr@univ-littoral.fr

Received April 5, 2000

ABSTRACT:

High precision index measurements (\(\Delta n/n \leq 10^{-5}\)) have been recently achieved on an AgGaS\(_2\) crystal using a spectral interferometry technique with a polarized white-light continuum. Up to now, these measurements are limited to the visible and near-infrared range, the most dispersive domain. We investigate the possibility to extend the technique to far infrared index measurements. We demonstrate a criterion depending only on group velocity dispersion and crystal thickness for planning future experiments.

KEYWORDS:

Spectral interferometry, ultrashort pulses, birefringent crystals, indices, group index, group velocity dispersion, AgGaS\(_2\) crystal
INTRODUCTION

Difference frequency mixing has been proved to be an excellent tool for generating continuous far-infrared light from two pump lasers in the visible or near-infrared range [1, 2, 5]. This kind of source can gather a wide continuous tunability and a very good spectral resolution for high resolution spectroscopic applications essentially. These capabilities are now recognized by industry which develops portable monitoring systems for pollutants detection. Moreover, the frequency-mixing field is now growing thanks to a better efficiency and a wider infrared transparency range of new nonlinear crystals.

The unavoidable phase-matching condition for frequency mixing involves the indices of the birefringent non-linear crystals. In previous papers [3, 4], we have pointed out the necessity to use non-destructive methods for measuring crystal dispersion characteristics. These latter can vary considerably from one crystal to the other one according to crystal growth conditions and it is important to measure the properties of the crystal effectively used in the frequency mixing experiment. In this way, we have developed two techniques for measuring the indices, group velocity and group velocity dispersion. The « temporal method » consists in measuring the time of flight of ultrashort pulses through the crystal [3]. This technique has been applied in the visible and near-infrared regions with a $10^{-4}$ relative accuracy on the indices. The second method uses the spectral interferences of white-light ultrashort pulses. We have shown how to extract the indices with a relative accuracy better than $10^{-5}$ from the analysis of the interferograms. Up to now, this powerful spectral interferometry technique is limited to the visible range and near-infrared region. This paper deals with the possibility of an infrared extension of the « spectral method ». In particular, we demonstrate a criterion for planning experiments in this low crystal dispersion region.