A Raman microscope with Snaphot Dual Polarization capability

Olivier ACHER,[1]* Aurélien THIEFFRY,[2] Artur ALEKSANYAN,[2]
[1]*HORIBA France SAS, 14 Boulevard Thomas Gobert, Passage Jobin-Yvon, 91120 Palaiseau, France;*
[2]*HORIBA France SAS, 455 Avenue Eugène Avinée, 51190 Loos, France*
olivier.acher@horiba.com

Keywords: polarization, Raman, microscopy

Raman microscopy is a technique that provides structural and chemical information with the spatial resolution of a confocal microscope. Part of this information is related to the polarization of the Raman scattered light for given laser excitation polarization. In conventional Raman microscopy, a polarization analyzer is used to measure only one Raman polarization. Recently, we demonstrated that a Raman spectrometer could be improved so as to measure simultaneously the Raman signal emitted with the same polarization as the exciting laser, and with the orthogonal polarization [1] (fig. 1-top).

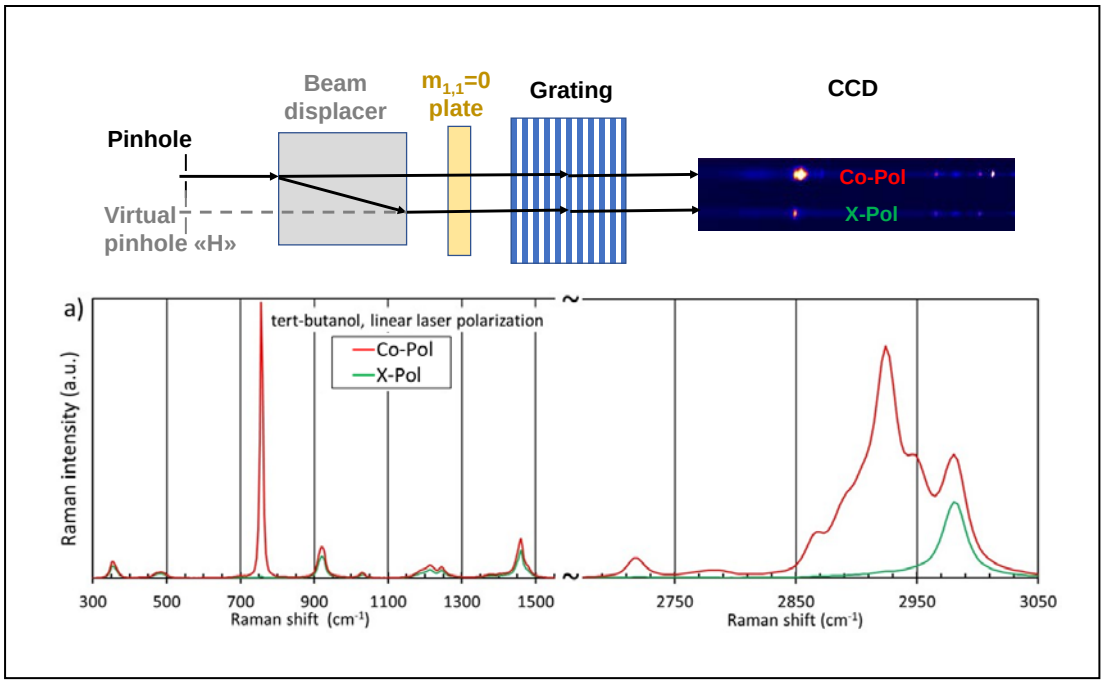

Fig. 1: (top) modified Raman spectrometer allowing dual polarization snapshot acquisition; (bottom) Polarized Raman spectrum of tert-butanol for a linearly polarized Raman excitation.

We made our design insensitive to the polarization dependence of the grating efficiency over the 350nm to 1000nm wavelength range. To achieve this, we derived the necessary and sufficient condition for a polarization-balancing component inserted between the polarization separation and the grating, expressed as a constraint on coefficients of its Muelle matrix. This condition is found less restrictive than the well-known quarter waveplates or half waveplates commonly used for this purpose. It is useful to construct a simple wideband solution.
The performance of the dual polarization Raman microscope is illustrated by raman spectra on several materials (fig.1-bottom).

[1]. O. Acher, A. Aleksanyan, and A. Thieffry, Opt. Express 30, 46734-46748 (2022).