**Magneto-Raman Spectroscopy on Correlated Electron System CaMn7O12**

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**Introduction**

Quadruple perovskite CaMn7O12 has attracted a lot of interest recently due its complex structure and observation of a large magnetically induced electric polarization [1, 2]. Temperature and magnetic field dependent investigations on this system will provide insight into magneto-electric and magneto-elastic coupling mechanisms in this system. A very recent infrared, THz and inelastic neutron scattering experiments observed spin modes of a probably magneto-electric character [3]. In order to confirm the nature of these excitations, more comprehensive spectroscopic investigations are called for. We attempted magneto-Raman spectroscopy on this system since this technique would not require samples of large size unlike many other spectroscopic tools while probing spin and lattice dynamics efficiently.



**Experimental**

Magneto-Raman spectroscopy was performed on single crystal of CaMn7O12 of about 400x400x400m3 size. The Raman spectra were measured in a backscattering Faraday geometry using a 532 nm laser excitation. The collected scattered light was guided via an optical fiber to a spectrometer equipped with a liquid-nitrogen-cooled CCD camera. The sample was placed on X-Y-Z actuator to obtain the best alignment as well as for position selectivity. Raman spectra were collected for over long acquisition times at temperature of 4 K and magnetic fields from 0 T to 12 T in steps of 1 T.

**Results and Discussion**

The plot of Raman spectra of CaMn7O12 as a function of magnetic fields up to 12 T at temperature of 4 K is shown in **Fig. 1**. The *Eg* phonon modes were observed with reasonable signal-to-noise ratio within the measured energy range of 200−1000 cm−1 in agreement with previous report at zero magnetic field [4]. The changes in the measured spectra with the application of magnetic fields up to 12 T were very small suggesting the magneto-electric changes induced by the magnetic field were not detectable in our experiment. However, it should be noted that the measurements were performed using unpolarized light which may not be the most efficient way to detect polarization sensitive lattice as well as electronic excitations. Therefore, efforts are being undertaken to perform linear polarization dependent magneto-Raman on these compounds to verify the current observations.

**Fig. 1.** Plot of Raman spectra of CaMn7O12 at the temperature of 4 K in magnetic fields up to 12 T. The energy and number of *Eg* phonon modes observed in this experiment are in agreement with the literature [4].

**Conclusions**

Magneto-Raman spectroscopy on the multiferroic compound CaMn7O12 was successfully performed at temperature of 4 K and magnetic fields up to 12 T. The Raman phonon modes were mostly insensitive to the application of the magnetic field suggesting that these modes are not influenced by the spin-lattice coupling in this compound. Further confirmation of this observation will be obtained using linear polarization dependent Raman scattering experiments.

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**References**

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