characteristics of $COO^-$ wagging mode and supports the protonation and the deprotonation of title compound.

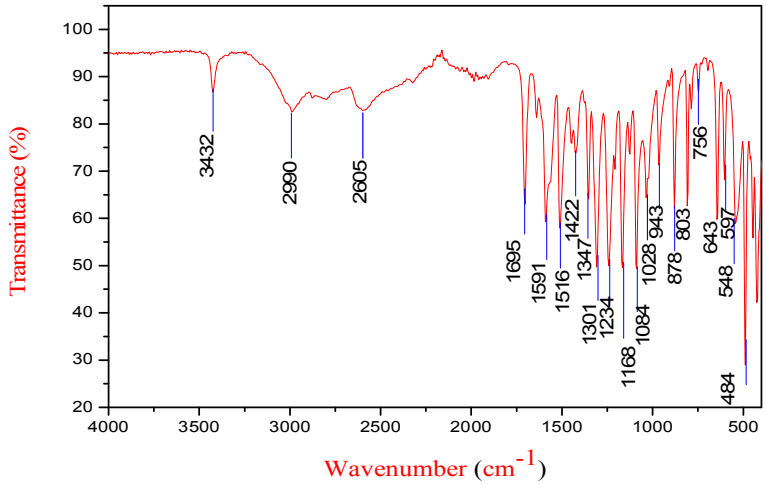


*Fig. 3. Infrared spectrum of PTM.*

**TG-DSC analysis.** From the TG-DSC curves (Fig.4), it was observed that, the title compound is thermally stable upto 166°C and the DSC thermal study confirms that the PTM crystal melts at 167°C.There was no major weight loss occured before 167° C. The weight loss started at 167°C due to the liberation of volatile substances such as CO, $CO_2$ and hydrocarbons. The final stage of decomposition started at 215°C and it prolonged upto 315°C. From these results, it was concluded that the PTM crystal is capable to function at temperature upto 166°C which could be useful in optical applications.

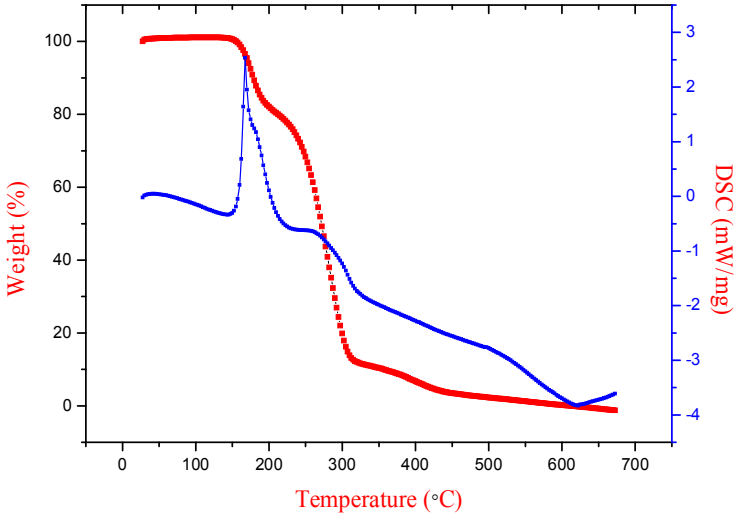


*Fig. 4. TG-DSC Thermogram of PTM.*

**UV-Visible transmission studies.** From the UV-Visible optical studies, the transmission range, transparency, absorption coefficient band gap energy were estimated which are the important parameters for optical applications. UV-vis spectrum of PTM showed good transparency about 72% with lower cut-off wavelength 206 nm. The optical band gap energy ($E_g$ ) was estimated using (Eqn.1), and it was found to be 5.8 eV as shown in Fig.5(a) and (b).

$$(\alpha h\upsilon)^2 = A\,(E_g - h\upsilon) \quad (1)$$

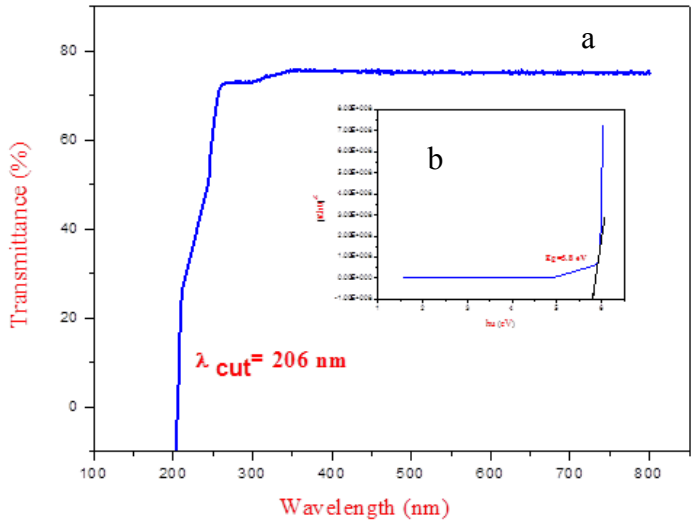


*Fig. 5. (a) UV-Visible transmission spectrum (b) Tauc's plot of PTM crystal.*

**Photoluminescence spectral studies.** Photoluminescence spectrum was recorded for PTM crystal at room temperature with an excitation wavelength of 250 nm as shown in Fig.6. The sharp spectrum showed a peak centered at 355 nm and no other visible emission peak has been observed. In the present study, a very strong intense emission peak observed at 355 nm ($E_g$ = 3.4 eV) corresponds to near band-edge exitons of as-gown crystal. It may be occurred due to the n → $\pi^*$ transition. Therefore, the PTM crystals might be suitable for UV filters and optoelectronic laser devices [4].

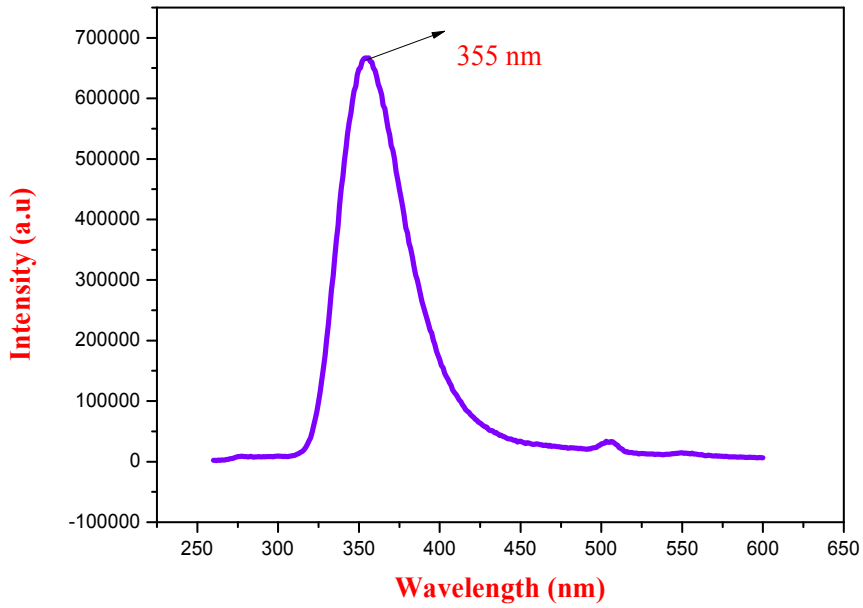


*Fig. 6. PL spectrum of PTM crystal with an excitation wavelength of 250 nm.*

**Nonlinear optical studies.** Third order nonlinear optical property of PTM crystal has been investigated by Z scan technique and it is an exact method to find the sign and magnitude of nonlinear refractive index ($n_2$) and nonlinear absorption coefficient (β) of the sample. It is the single beam

method, which utilizes self focusing or self defocusing phenomena in optical nonlinear materials [5]. The Z-scan measurement traces in closed aperture mode and open aperture are shown in Fig. 7(a) and Fig. 7(b) respectively.

The third order nonlinear optical susceptibility was calculated using the relation,

$$\chi^{(3)}= \sqrt{(R_e\chi^{(3)})^2 + (I_m\chi^{(3)})^2} \quad (2)$$

The third-order nonlinear refractive index ($n_2$) = 3.41 × $10^{-8}$ $cm^2$/W, nonlinear absorption coefficient (β) =0.03 × $10^{-4}$ cm/W and third order non-linear susceptibility ($\chi^{(3)}$) = 3.77 × $10^{-6}$ esu were estimated by Z- scan technique.

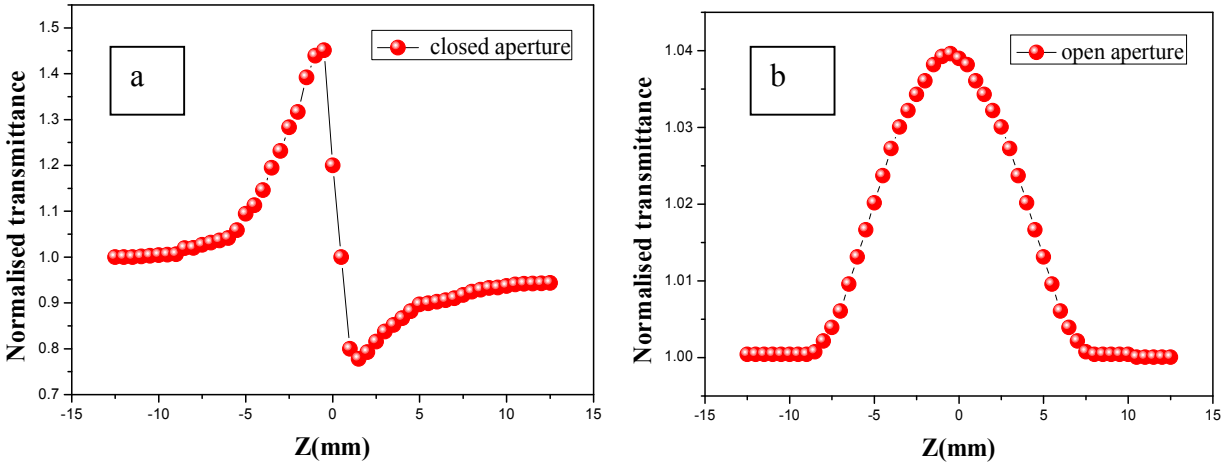


*Fig. 7 (a) Z-scan plot of PTM crystal in closed aperture (b) Z-scan plot of PTM crystal in open aperture.*

**Summary.** Third-order nonlinear optical PTM single crystal with 14x3x2 $mm^3$ dimension was grown by slow evaporation technique. Single crystal X-ray diffraction studies reveal that the grown PTM crystal belongs to monoclinic system with $P2_1/c$ space group. The functional groups present in PTM were confirmed by FTIR spectral studies. TG-DSC thermogram revealed the thermal stability of PTM crystal. UV-visible study showed the good transmission region and the cut-off wavelength, band gap energy were found to be 206 nm and 5.8 eV respectively. Photoluminescence spectral analysis suggests that PTM could be used in UV filters and optoelectronic devices. Z-scan measurements revealed the values of third-order nonlinear refractive index, nonlinear absorption coefficient and third order non-linear susceptibility.

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