Supporting Information

Nonlinear Fano-Raman Line-shape Evolution: Direct Evidence of Creation & Annihilation of Interferons in V_2O_5

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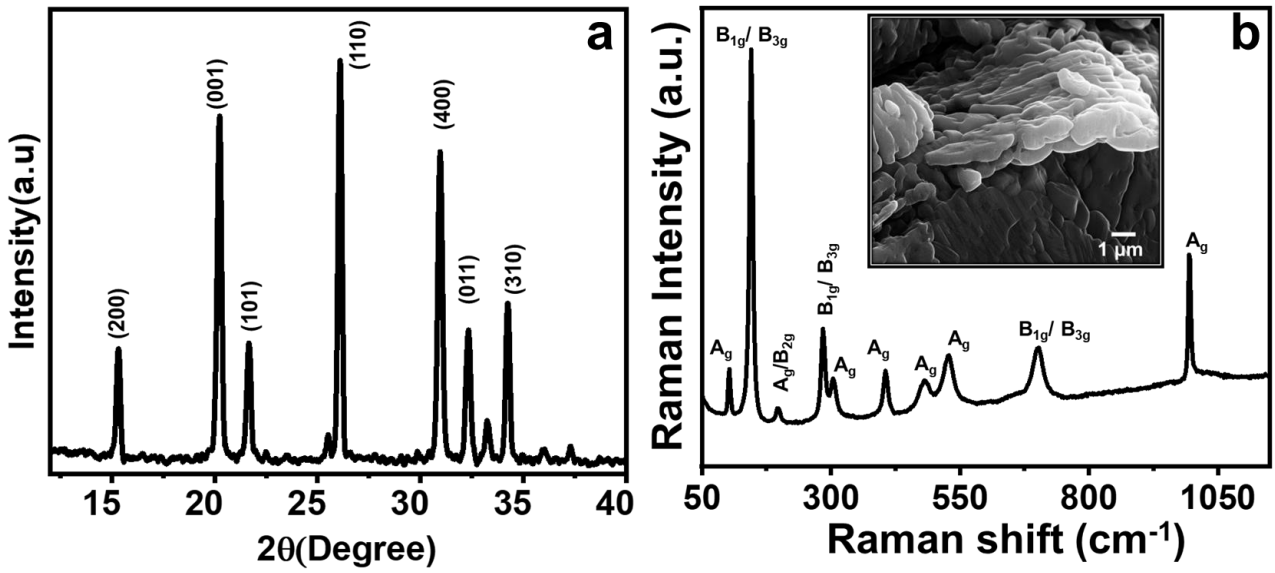

Figure S1: (a) X-ray diffraction pattern of V_2O_5 powder and (b) Raman spectrum of V_2O_5 powder recorded at 532 nm along with its SEM micrograph in inset.

The sample's purity and phase uniformity are validated by the powder XRD pattern (Figure S1a). According to the literature (JCPDS # 41–1426)[1], the diffraction peaks found in the XRD pattern (Figure 1b) at 2θ = 15.32°, 20.24°, 21.66°, 26.1°, 30.96°, 32.34°, and 34.24° correspond to the (hkl) plane of (200), (001), (101), (110), (400), (011), and (310) corresponding to crystalline V_2O_5. The XRD pattern of V_2O_5 is confirming that the material is in the pure orthorhombic phase. According to group theory analysis, V_2O_5 belongs to Pmmn space group and D_{2h} point group[2]. This analysis predicts twenty-one Raman active modes at Γ point, $7A_g+7B_{2g}+3b_{1g}+4B_{3g}$. The ten Raman modes match well with the reported reference Raman spectrum of V_2O_5 (Figure S1b). The Raman peaks (in cm^{-1} units) observed at 102(A_g), 144(B_{1g}/B_{3g}), 195(A_g/B_{2g}), 283(B_{1g}/B_{3g}), 301(A_g), 403(A_g), 483(A_g), 523(A_g), 701(B_{1g}/B_{3g}) and 994 (A_g) further validates the presence of pure orthorhombic phase of V_2O_5 as indicated by XRD pattern above. The SEM micrographs (inset of Figure S1b) of V_2O_5 powder consist of elongated micro sized particles which are stacked together.

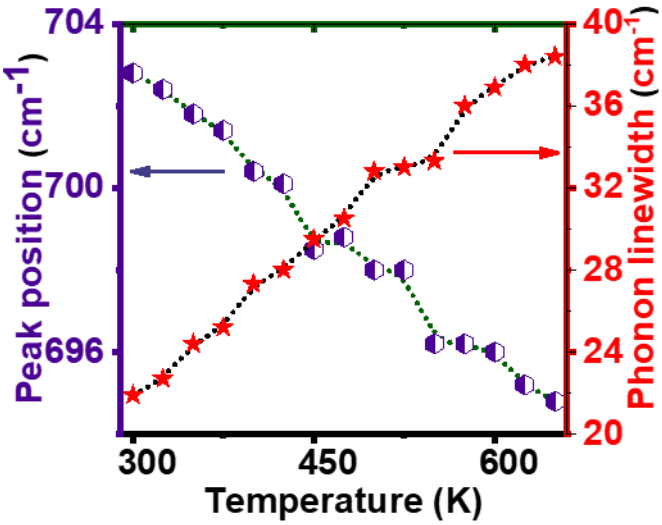

Figure S2: Variation of peak position (blue arrow) and phonon line width (Red arrow) with temperature of B_{1g} Raman mode (702 cm^{-1}) of V_2O_5.

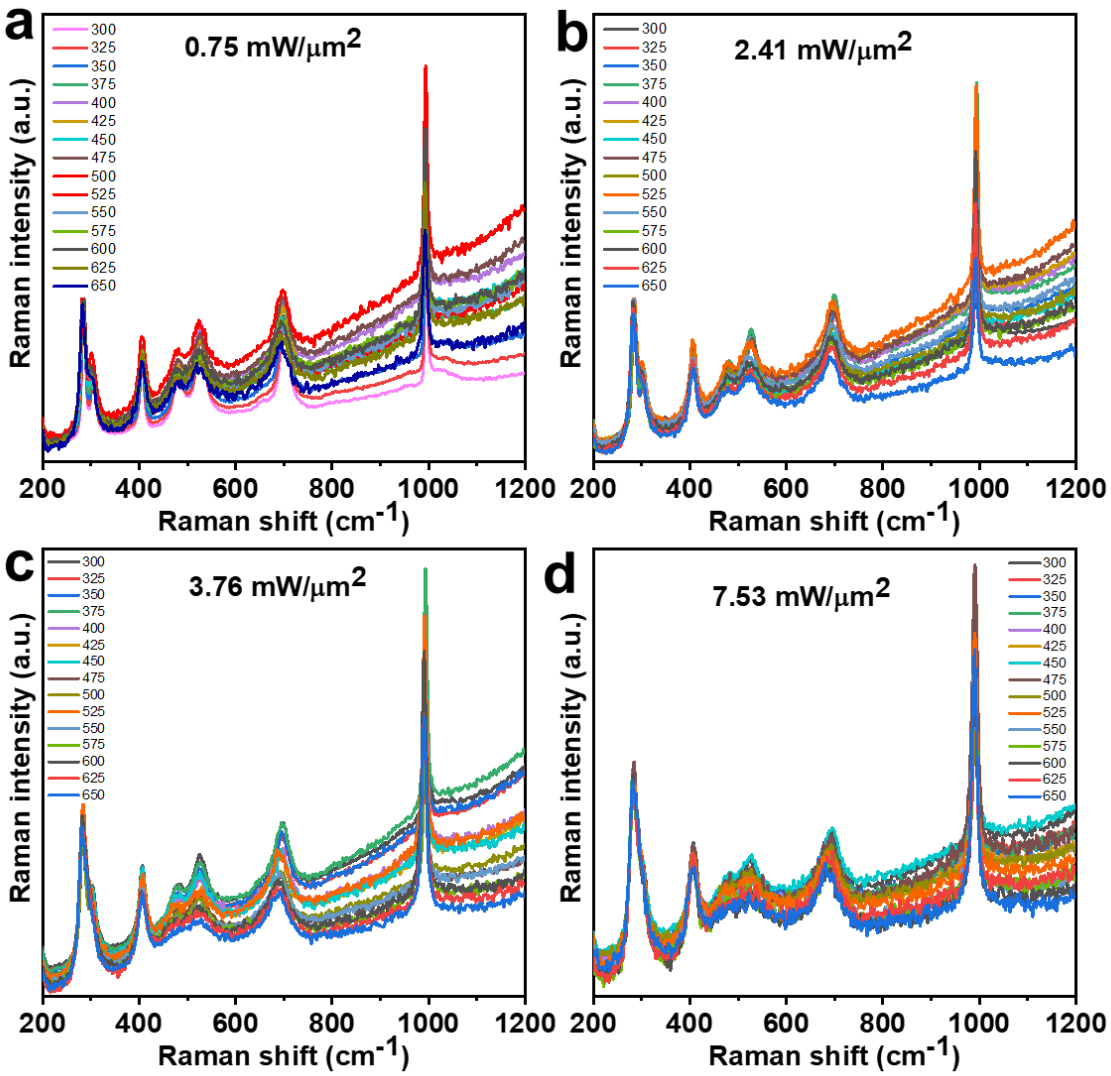

Figure S3: Temperature dependent Raman spectra of V_2O_5 in the range 200 cm^{-1} to 1200 cm^{-1} for laser flux (a) 0.75 mW/ μm^2, (b) 2.41 mW/ μm^2, (c) 3.76 mW/ μm^2 and (d) 7.53 mW/ μm^2.

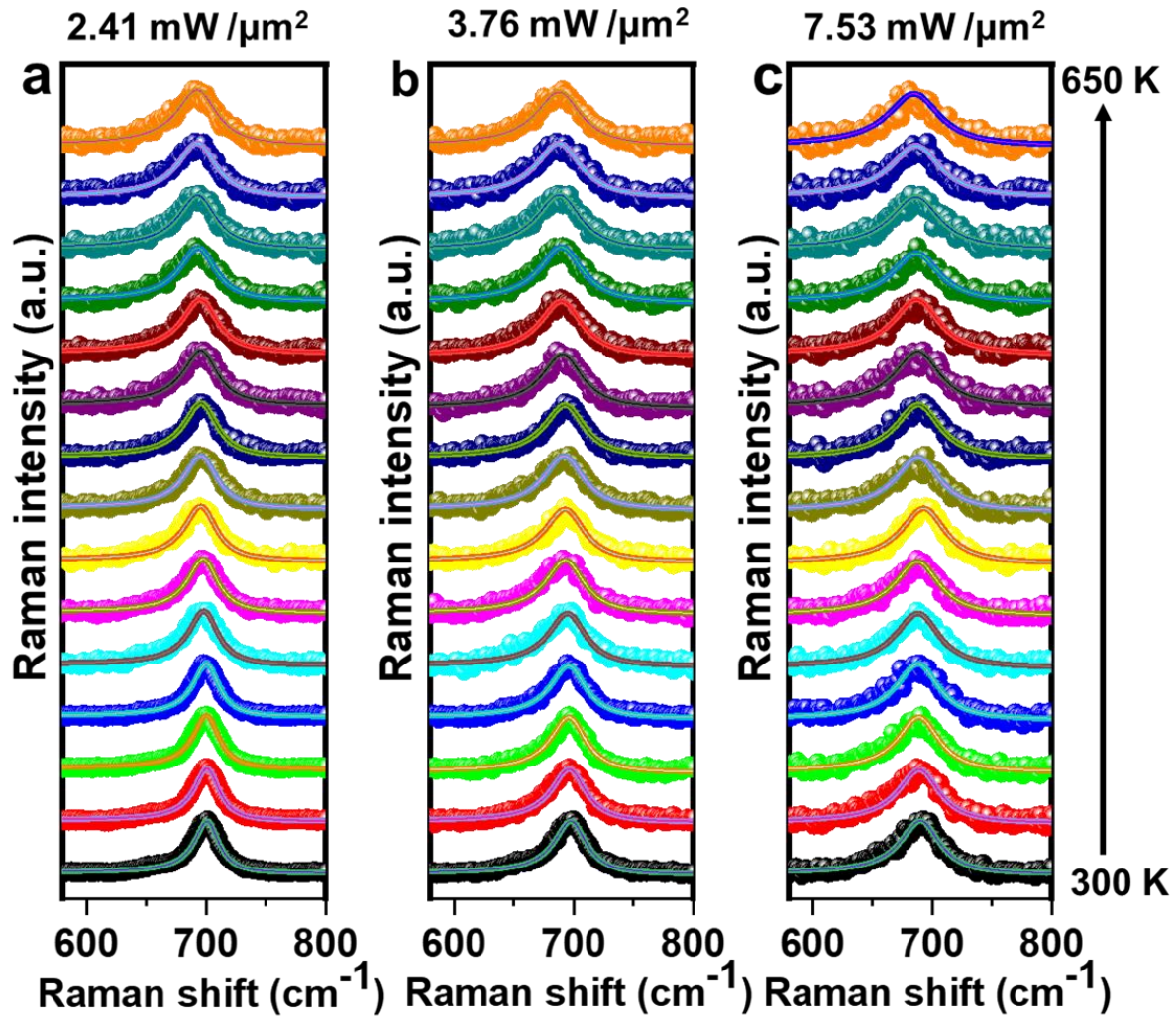

Figure S4: Theoretical Fano fitting of temperature dependent B_{1g} Raman mode (702 cm^{-1}) of V_2O_5 with equation 1 for laser power 2.41 mW/μm^2 (a), 3.76 mW/μm^2 (b) and 7.53 mW/μm^2 (c)

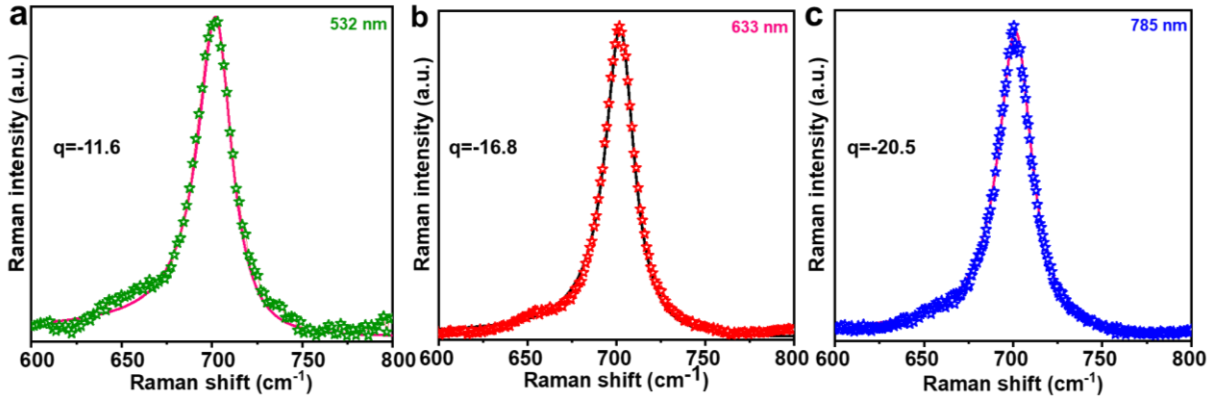

Figure S5: Wavelength dependent B_{1g} Raman mode (702 cm^{-1}) of V_2O_5 fitted with Eq. 1 recorded at excitation wavelength of (a) 532 nm ,(b) 633 nm and (c) 785 nm.

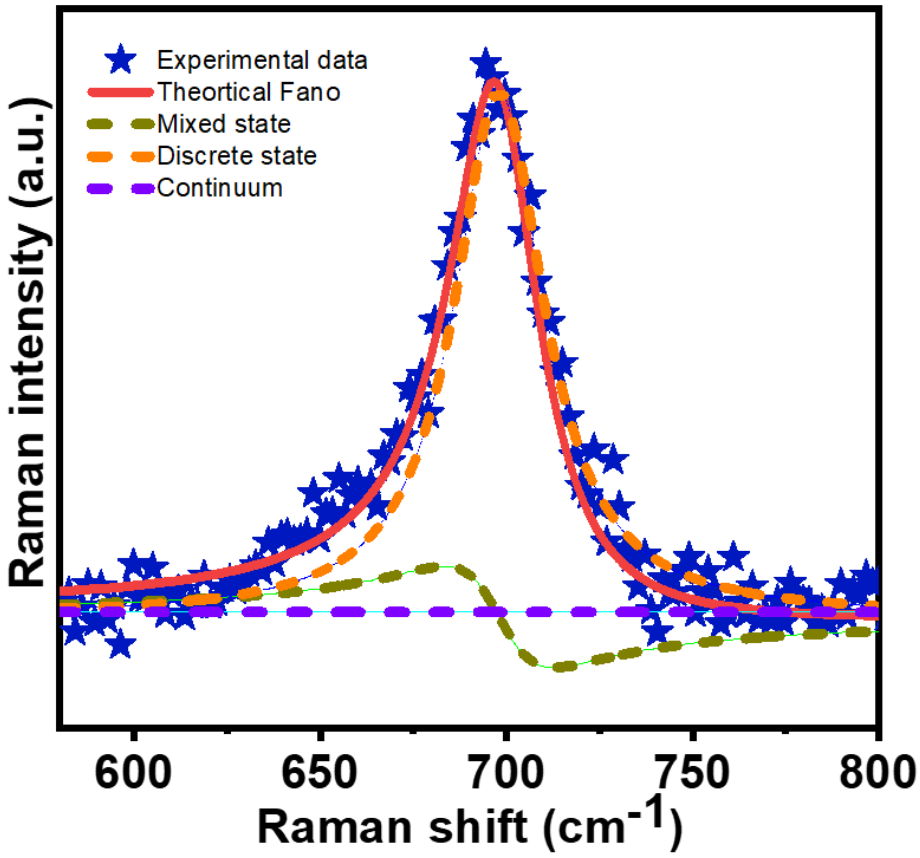

Figure S6: Theoretical Fano fitting of B_{1g} Raman mode (702 cm^{-1}) of V_2O_5 with Eq. 1 at maximum interferon population (at 450K) for laser power 0.75 $mW/\mu m^2$ and its superimposed mixed state of discrete phonon and electronic continuum (Green curve).

Table S1: (Fitting parameters of Equation 3 for different laser power)

S. No.	Laser flux ($mW/\mu m^2$)	α (K)	β (Watt)	T_M (K)
1	0.75	270	0.000095	440
2	2.41	565	0.000219	380
3	3.76	615	0.000318	355
4	7.53	775	0.000548	250

References

(1) Pradeep, I.; Ranjith Kumar, E.; Suriyanarayanan, N.; Srinivas, Ch.; Mehar, M. V. K. Effects of Doping Concentration on Structural, Morphological, Optical and Electrical Properties of Tungsten Doped V2O5 Nanorods. *Ceramics International* **2018**, *44* (6), 7098–7109. https://doi.org/10.1016/j.ceramint.2018.01.149.

(2) Abello, L.; Husson, E.; Repelin, Y.; Lucazeau, G. Vibrational Spectra and Valence Force Field of Crystalline V2O5. *Spectrochimica Acta Part A: Molecular Spectroscopy* **1983**, *39* (7), 641–651. https://doi.org/10.1016/0584-8539(83)80040-3.