Electronic Supplementary Material (ESI) for RSC Advances.

Supplementary information

For

Influence of Gamma-ray irradiations & post-annealing studies on pentacene films: the anisotropic effects on structural and electronic properties

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Atomic Force Microscopy (AFM)

AFM was performed by tapping mode across 2 µm * 2 µm at various positions for pristine and irradiated samples. Fig. S1 revealed no significant difference in the morphology of the samples before and after irradiation. The particle size of the pentacene films are around 18.8 nm.

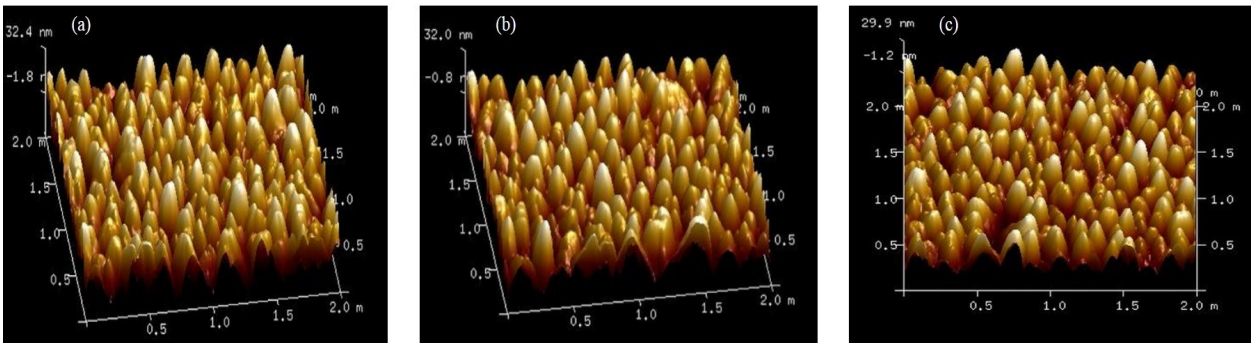

Fig. S1 AFM topographies (2 µm x 2 µm) of: (a) Pristine, (b) 400 Gy and (c) 3000 Gy irradiated pentacene thin films.

Scanning Electron Microscopy (SEM)

To investigate and confirm the morphological changes, SEM was performed. The morphology of the films were took at various positions in the sample and the results of SEM are consistent with the AFM results. No significant change can be observed in the morphology before and after γ-ray irradiation, as shown in Fig. S2.

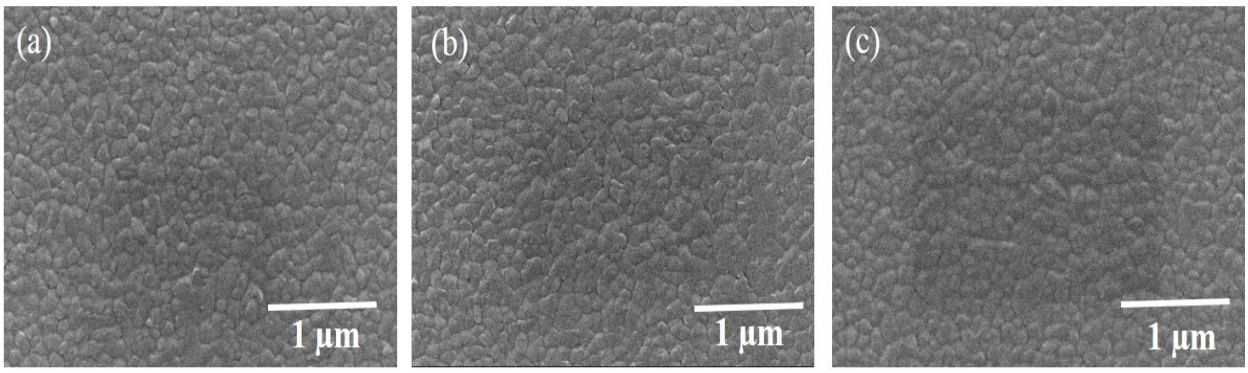

Fig. S2 SEM micrographs of pentacene thin films at various doses: (a) pristine; (b) 400 Gy and (c) 3000 Gy irradiated pentacene thin films.

Raman spectroscopy

To determine the change in the molecular vibration of the pentacene molecule before and after γ-ray irradiation, Raman spectroscopy was carried out. Fig. S3 shows the results of Raman spectroscopy of the samples before and after irradiation. No significant change can be found after gamma ray irradiation.

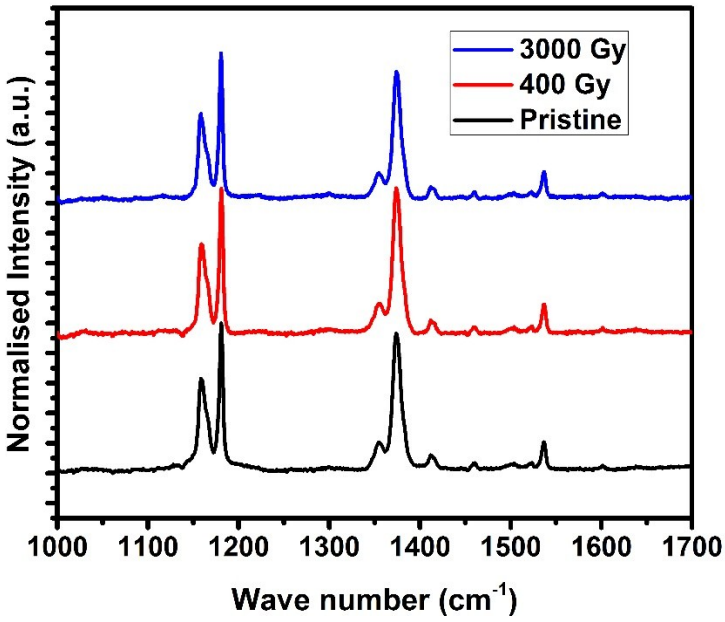

Fig. S3 Raman spectra of pentacene thin films at various doses.

X-ray photoemission spectroscopy (XPS)

To understand the effects of gamma irradiation on the chemical states of pentacene films, XPS measurements were carried out. XPS measurements for carbon K-edge were measured with an incident photon energy of about 1150 eV. It can be seen from Fig. S4, that there is no observable chemical shift in the binding energy before and after gamma irradiations. In comparison with Raval group [1], where they observed a shift of about 0.2 eV towards lower binding energy after exposure to 100 Gy. This shift may be due to the different degree of oxidation existing on the surface of the pentacene molecule. To avoid the discrepancies due to instrumentation error, Au standard was measured after each sample for calibration purpose.

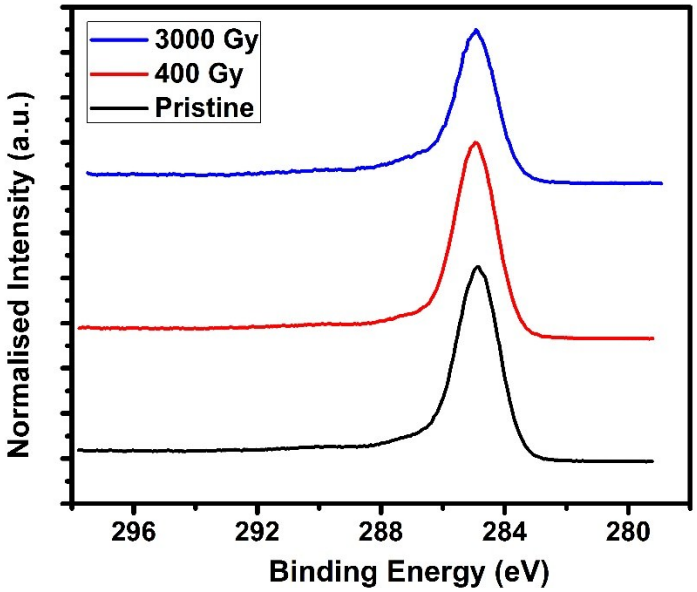

Fig. S4 XPS spectra of normalized C-K edge of pentacene films irradiated at various doses.

References

1. H. N. Raval, D. S. Sutar, P. R. Nair and V. R. Rao, *Organic Electronics*, 2013, **14**, 1467-1476.

Hall Effect measurement device configuration

Fig. S5 shows the schematic representation for the device to measure the carrier concentration in the pentacene thin films before and after γ-ray irradiation.

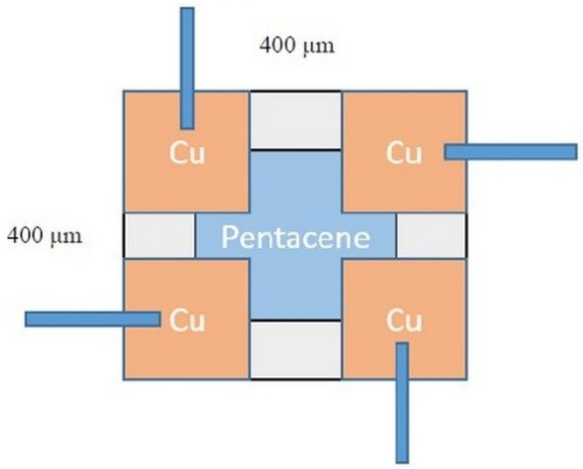

Fig. S5 Schematic pattern for Hall Effect measurement of pentacene films.