Electronic Supplementary Material (ESI) for Journal of Materials Chemistry C.

Supplementary Material

Thin film characterization,
FESEM, EDS

The FESEM characterization (Zeiss, Auriga) was performed to know the surface morphology of the thin film. For elemental analysis selected portion of the thin film was characterization by the EDS. EDS spectrum detecting peaks of Bi and Te elements, without impurity and atomic weight percentage was found about Bi = 40.28 and Te = 59.72 respectively, which indicates that's the ratio between Bi and Te is nearly 2:3. (*e.g.*, Te-Bi-Te-Bi-Te), which corresponds to the Bi2Te3 formula.

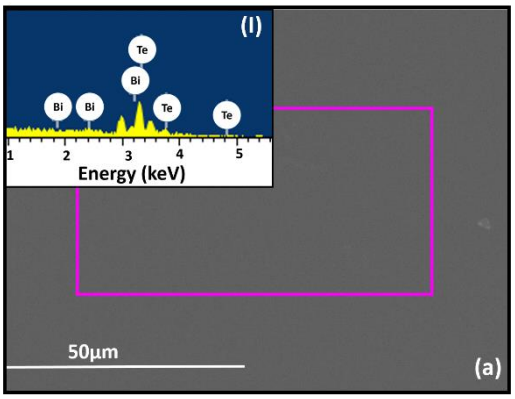

Figure. S1 FESEM image of the deposited thin film on PET substrate inset I is the EDS data of the selected portion.

Raman

The Bi_2Te_3 thin film was characterized by the Raman spectrum, the spectra are recorded under 785 nm excitation. Three optical phonon peaks E^2_g (~101.8 cm-1), and A^2_{1g} (~132.5 cm-1) were observed & identified. These peaks are very close to previous measured and assigned Raman peaks of the Bi_2Te_3 sample. The modes labeled "A" and "E" indicated the out-plane and in-plane lattice vibration, respectively. Where "g" denotes Raman-active modes. In figure 1. Represent the Represent the Raman characterization of the Bi_2Te_3 film at 0 bending cycle (Red plot), after 100 bending cycle (blue plot) and after 500 bending cycle (green plot).

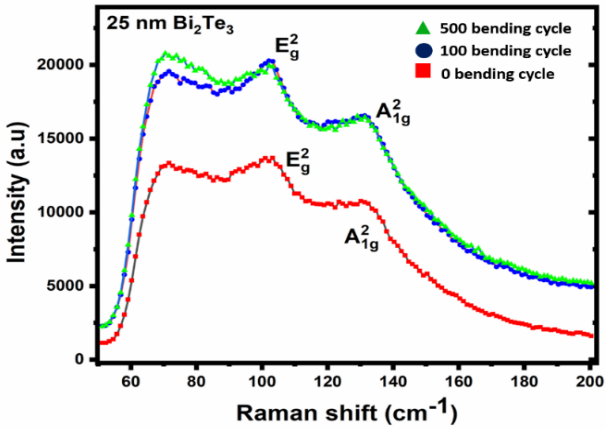

Figure S2. Represent the Raman characterization of the Bi_2Te_3 film at 0 bending cycle (Red plot), after 100 bending cycle (blue plot) and after 500 bending cycle (green plot).

Bi_2Te_3 films	Bending angle	E^1_g	A^1_{1g}	$A_{1u}{}^1$	E^2_g	$A_{1u}{}^2$	A^2_{1g}	Comments
25 nm	0	----	----	----	102.2	----	132.05	This work
	100	----	----	----	101.8	----	131.2	This work
	500	----	----	----	101.8	----	131.2	This work
4 nm		38.9	60.3	----	101.4	116.7	132.9	(1)
10 nm		38.5	60.7	----	101.4	116.5	132.9	(2)
50 nm		39	61.1		101.5	116	132.39	(2)

1) One-Step Synthesis of Bismuth Telluride Nanosheets of a Few Quintuple Layers in Thickness** Yimin Zhao, Robert W. Hughes, Zixue Su, Wuzong Zhou, and Duncan H. Gregory*

2) K. Shahil, M. Hossain, V. Goyal and A. Balandin, *J. App. Phys.*, 2012, 111, 054305.

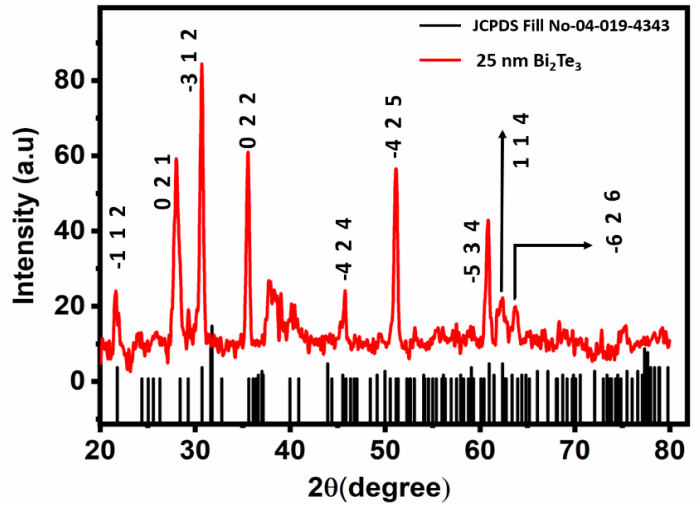

Figure S3. Represent the XRD characterization of the Bi_2Te_3 film.

XRD Analysis

The crystal structure of 3D TIs, Bi_2Te_3, is rhombohedral with a space group of R3m, which is due to the stacked nature of atomic planes of layered tetradymite materials. The primitive unit cell of the rhombohedral crystal structure contains one Bi atom and two non-equivalent sites of Te atoms (Te1 and Te2). In TIs, each quintuple layer (QL) is made up of five atomic planes that are stacked in a closely packed FCC structure ($Te_1(Se_1)$-Bi(Sb)-$Te_2(Se_2)$-Bi(Sb)-$Te_1(Se_1)$). The five atomic layers structure acts as a building block that is periodically repeated along the c-axis with lattice constants, a = 4.133 Å, c = 28.640 Å for Bi_2Se_3 and a = 4.33 Å, c = 30.42 Å for Bi_2Te_3. The interatomic distance between Te1-Te1, Bi-Te_1, and Bi-Te_2 are 3.66 Å, 3.07 Å, and 3.25 Å, respectively. The Van-der Waal type interaction is assumed between Te_1-Te_1 due to the large interatomic distances in Te_1-Te_1 as compared to Bi-Te_1 and Bi-Te_2. The weak Van-der Waal type interaction between QLs in TIs offers an easy approach to cleave the surface along the [111] plane. These QLs are bonded with covalent bonding.

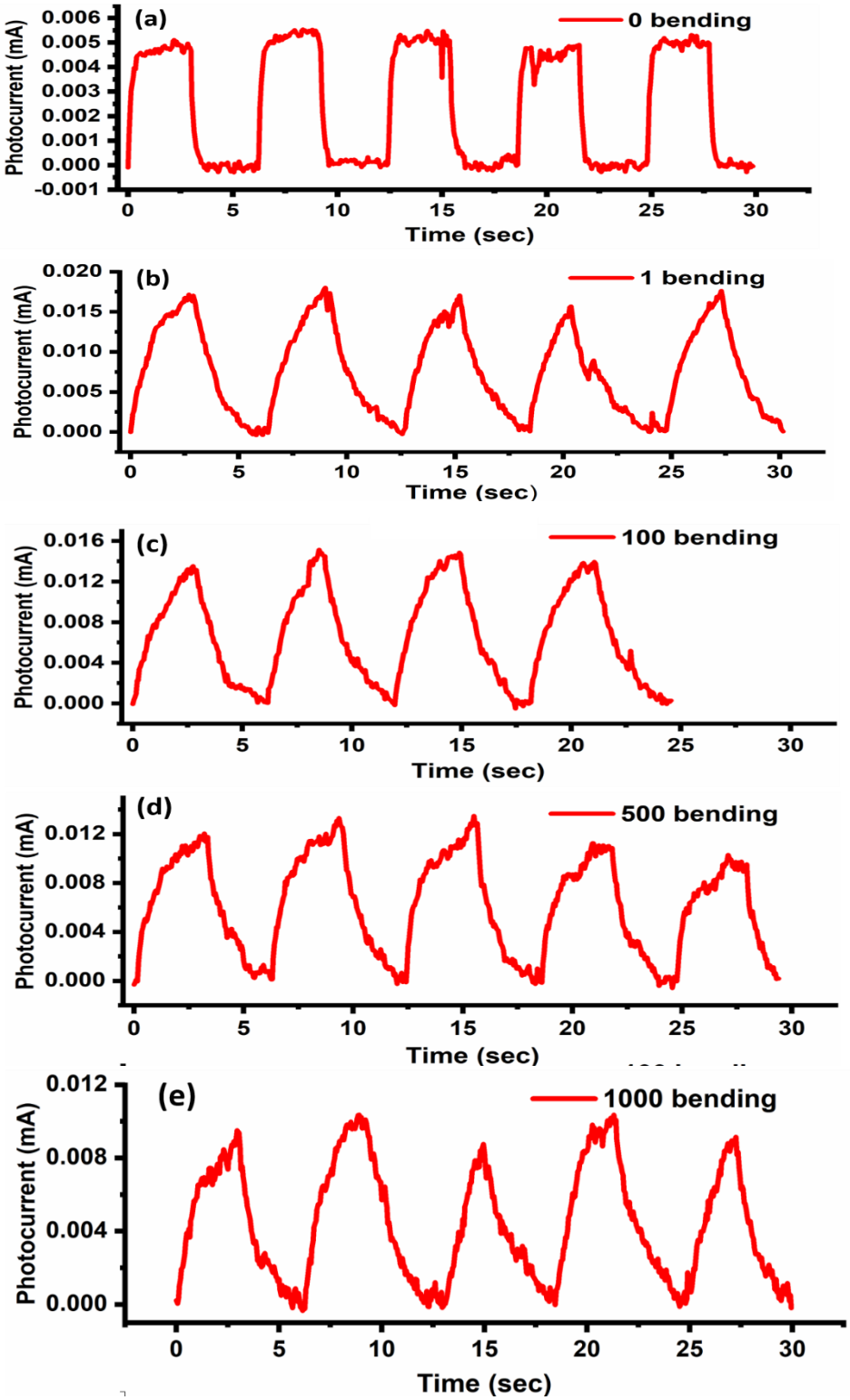

Figure S4. (a-e) Shows the photocurrent as function of time at various bending cycle 0, 1, 100, 500 and 1000 respectively.

In response to the reviewer's comments, we have included Figure S4 (a-e) in our supplementary materials. This figure displays five cycles of photocurrent as a function of time, each corresponding to different bending cycles. This addition ensures that each row contains the

required minimum of five data points, addressing the reviewer's suggestion and enhancing the manuscript quality.