

Title	2D nanosheet paint from solvent-exfoliated Bi ₂ Te ₃ ink
Authors	Carroll, Elaine;Buckley, Darragh;Mogili, N. V. V.;McNulty, David;Moreno, M. Sergio;Glynn, Colm;Collins, Gillian;Holmes, Justin D.;Razeeb, Kafil M.;O'Dwyer, Colm
Publication date	2017-08-09
Original Citation	Carroll, E., Buckley, D., Mogili, N. V. V., McNulty, D., Moreno, M. S., Glynn, C., Collins, G., Holmes, J. D., Razeeb, K. M. and O'Dwyer, C. (2017) '2D nanosheet paint from solvent-exfoliated Bi ₂ Te ₃ ink', Chemistry of Materials, 29(17), pp. 7390-7400. doi:10.1021/acs.chemmater.7b02321
Type of publication	Article (peer-reviewed)
Link to publisher's version	10.1021/acs.chemmater.7b02321
Rights	© 2017 American Chemical Society. This is an open access article published under an ACS AuthorChoice License, which permits copying and redistribution of the article or any adaptations for non-commercial purposes. - http://pubs.acs.org/page/policy/authorchoice_termsofuse.html
Download date	2024-04-25 08:43:39
Item downloaded from	https://hdl.handle.net/10468/4687



UCC

University College Cork, Ireland
 Coláiste na hOllscoile Corcaigh

Supporting Information for

2D Nanosheet Paint from Solvent Exfoliated Bi_2Te_3 Ink

Elaine Carroll¹, Darragh Buckley¹, N. Vishnu V. Mogili², David McNulty¹, M. Sergio Moreno³, Colm Glynn¹, Gillian Collins¹, Justin D. Holmes^{1,4,5}, Kafil M. Razeeb⁵, and Colm O'Dwyer^{1,5*}

¹ School of Chemistry, University College Cork, Cork, T12 YN60, Ireland

² Centro Nacional de Pesquisa em Energia e Materiais (CNPEM), Brazilian Nanotechnology National Laboratory (LNNano), CEP 13083-970, Campinas/SP, Brazil

³ Centro Atómico Bariloche, 8400 - S. C. de Bariloche, Argentina

⁴ AMBER@CRANN, Trinity College Dublin, Dublin 2, Ireland

⁵ Micro-Nano Systems Centre, Tyndall National Institute, Lee Maltings, Cork, T12 R5CP, Ireland

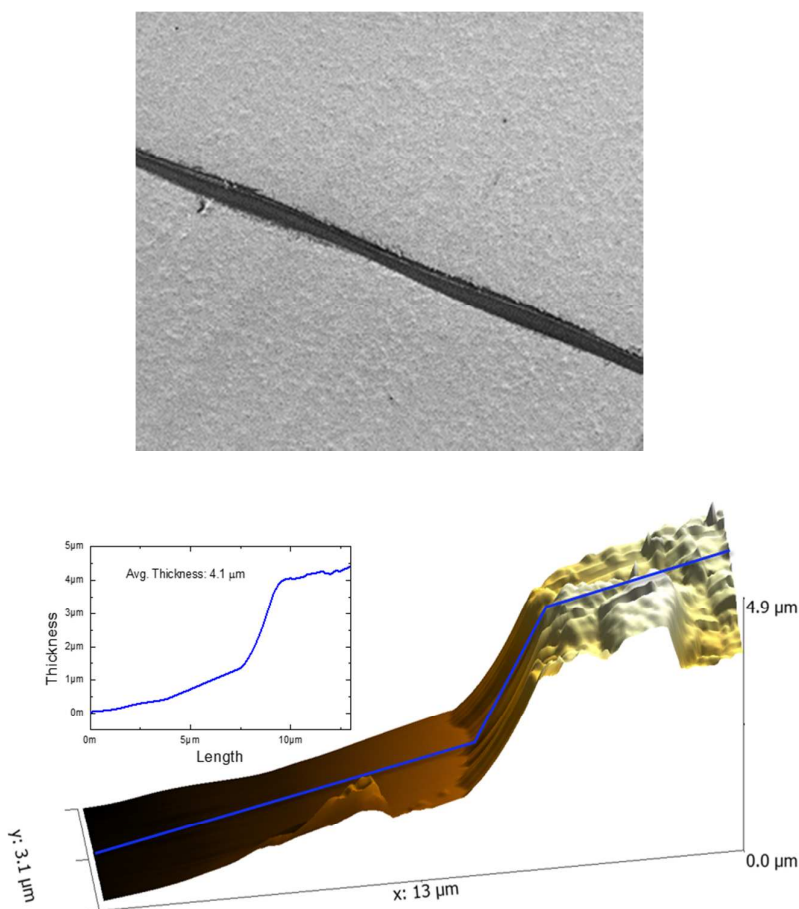


Figure S1. SEM image of a 2D Bi_2Te_3 nanosheet paint scored to obtain AFM profiles of the painted film height. the average height for a painted film is typically $\sim 4 \mu\text{m}$.

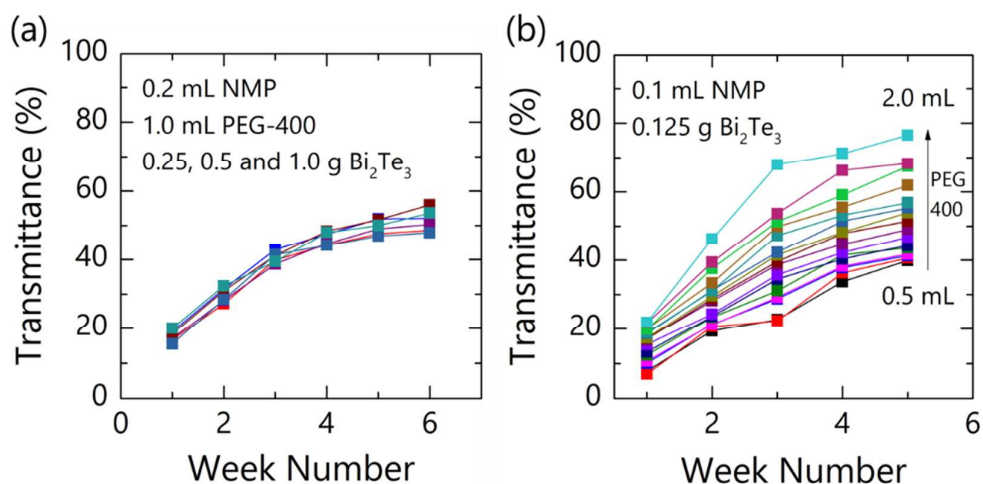


Figure S2. (a) Optical transmittance at $\lambda = 532$ nm of 2D Bi_2Te_3 suspensions in 0.2 mL NMP + 1.0 mL PEG monitored over a 6-week period. Two separate suspensions (6 solutions overall) were measured for each mass (0.25, 0.5 and 1.0 g) of Bi_2Te_3 (b) Optical transmittance of 0.125 g 2D Bi_2Te_3 suspensions in 0.1 mL NMP over a 5-week period with different volume additions of PEG (0.5 - 2.0 mL).

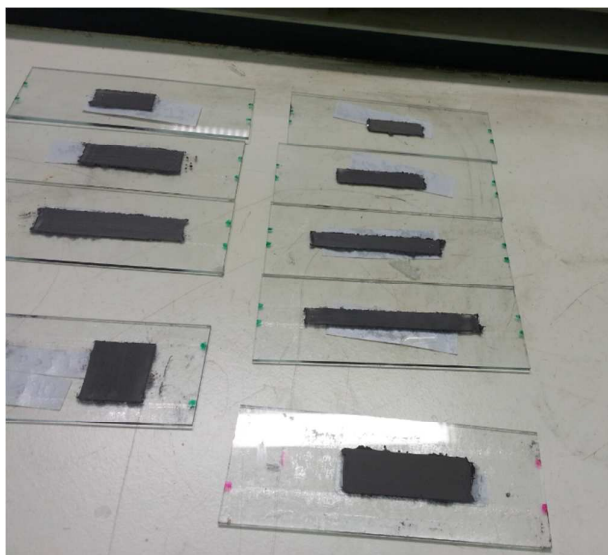


Figure S3. Photographs of 2D Bi_2Te_3 nanosheet paint on glass slides for a series of different aspect ratios. These images were acquired after I-V measurements and heating. Painted strips are visually near-identical to as-painted films even after heating, and no cracking or delamination is observed.

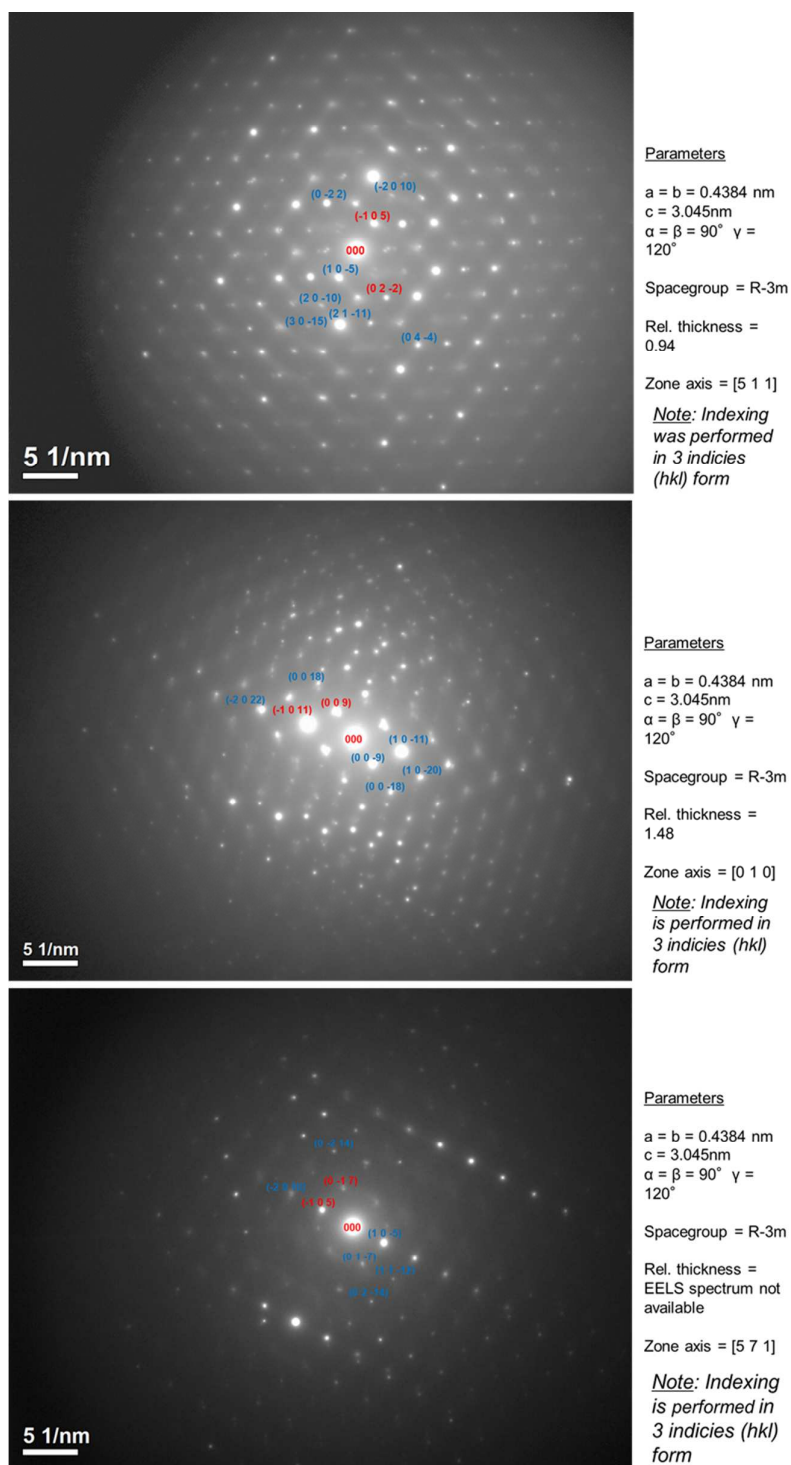


Figure S4. Selected area electron diffraction measurements of few QL Bi_2Te_3 along several zone axes, which are perfectly index to rhombohedral Bi_2Te_3 . No matches are found for other Bi-Te phases such as Bi_2Te , Bi_4Te_3 , or BiTe .

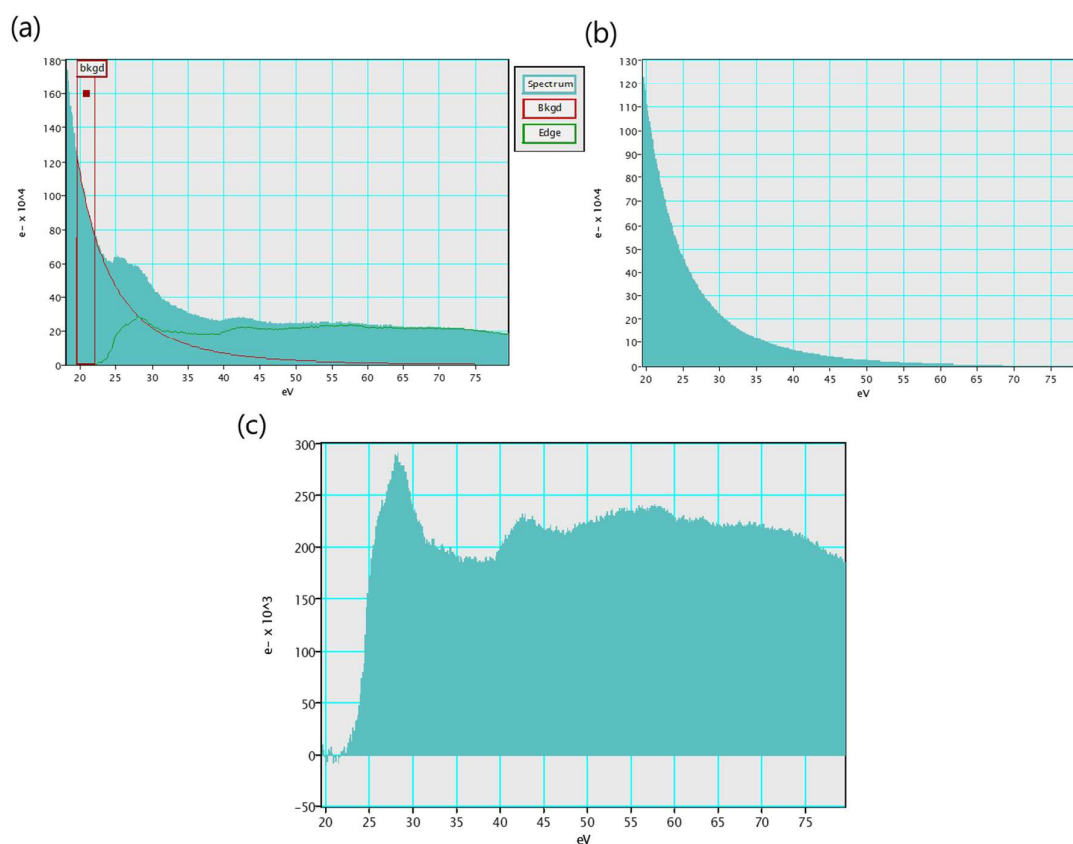


Figure S5. (a) Experimentally measured EELS spectrum and (b) extracted background signal. (c) Background-subtracted low-loss EELS spectrum of the Bi_2Te_3 few QL material, shown in the main text as Figure 3(e).

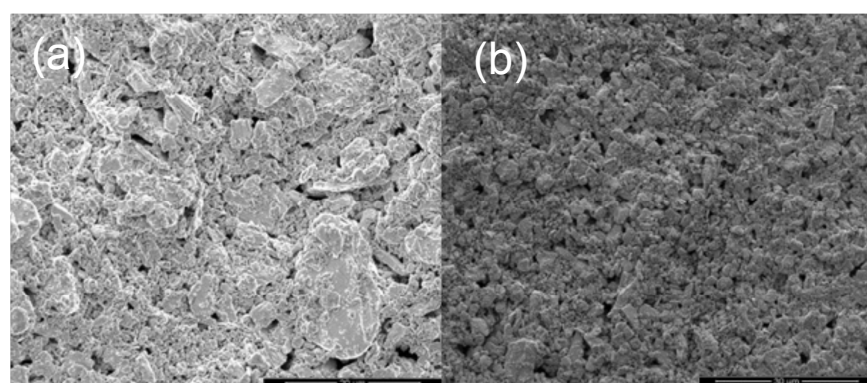


Figure S6. SEM images of the granular morphology from (a) CHP and (b) NMP exfoliated Bi_2Te_3 . After sonication, reflux and exfoliation in CHP, we consistently observe larger clumps of non-exfoliated regions of material in (a).

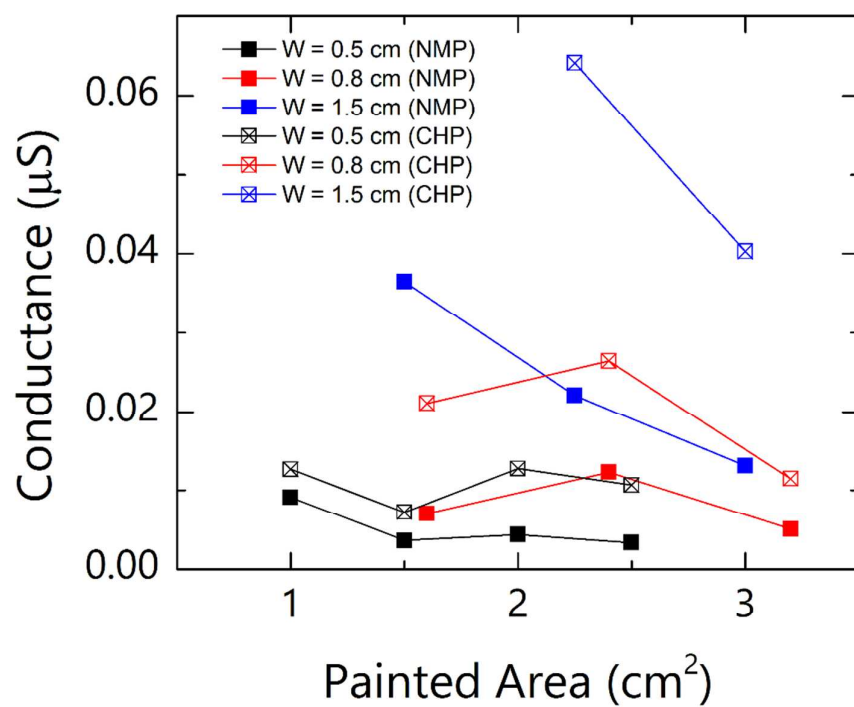


Figure S7. Conductance of Bi_2Te_3 paint strips versus painted area for a series of aspect ratios after exfoliation in CHP and NMP with identical Bi_2Te_3 concentrations of 4 kg dm^{-3} .

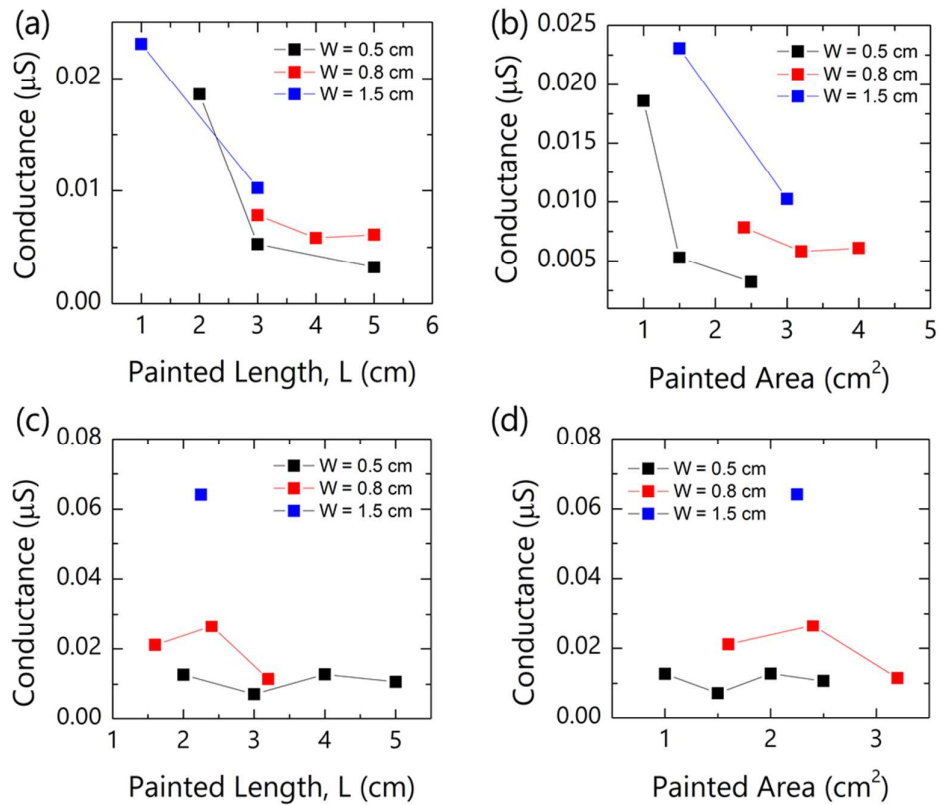


Figure S8. Conductance measured along the painting direction of Bi_2Te_3 paint strips for a series of aspect ratios after exfoliation in CHP with nominal Bi_2Te_3 concentrations of (a,b) 4 kg dm^{-3} and (c,d) 1 kg dm^{-3} .

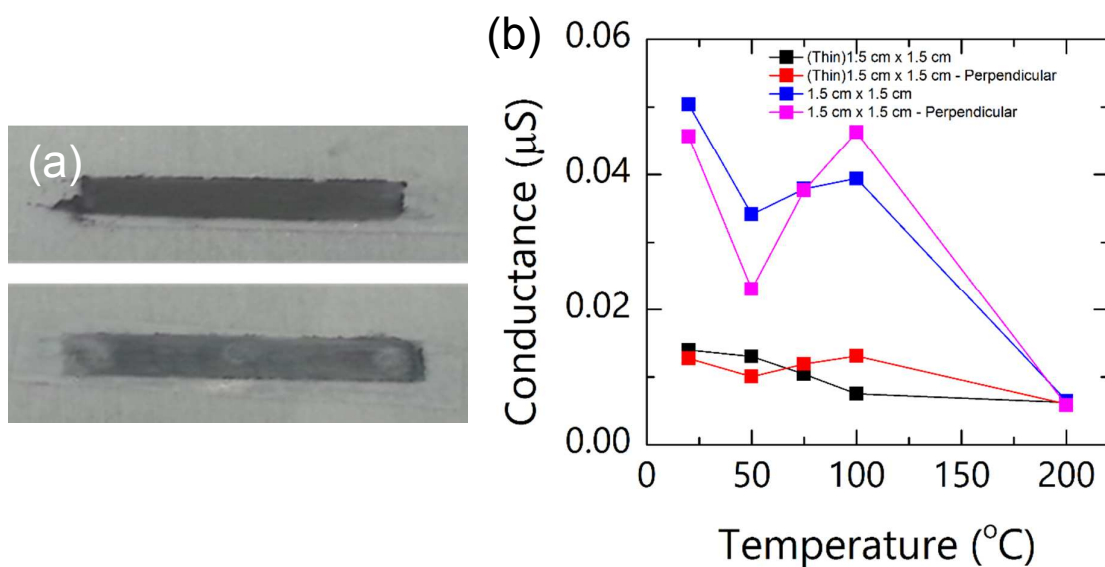


Figure S9. (a) Two paint strips of nominally identical length and width, one normal coating, another of markedly reduced thickness at a lower filler fraction of 1 kg dm^{-3} Bi_2Te_3 concentration exfoliated in CHP and PEG. (b) Electrical conductance measured parallel and perpendicular to the painting direction for two paint films (thin and thick) from low concentration Bi_2Te_3 paint for an aspect ratio = 1 ($1.5\text{ cm} \times 1.5\text{ cm}$). This trend also holds at elevated temperatures up to 200°C .

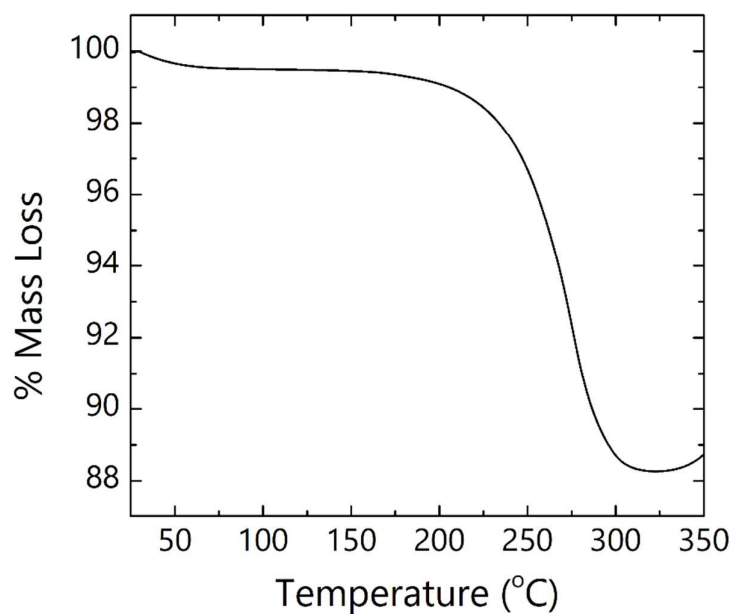


Figure S10. Thermogravimetric analysis of the Bi_2Te_3 paint material. Water loss ($\sim 0.5\%$ mass loss) is initially observed during heating in air. A single step decomposition

subsequently occurs just above 220 °C, comprising a 12% mass loss. An atmospheric reaction above ~325 °C causes a slight (~0.5%) mass gain.