Microfactory Design for Valorization of E-Waste Plastics (Acrylonitrile-Butadiene-Styrene, Polycarbonate, and Polypropylene) on Additive Manufacturing Sector

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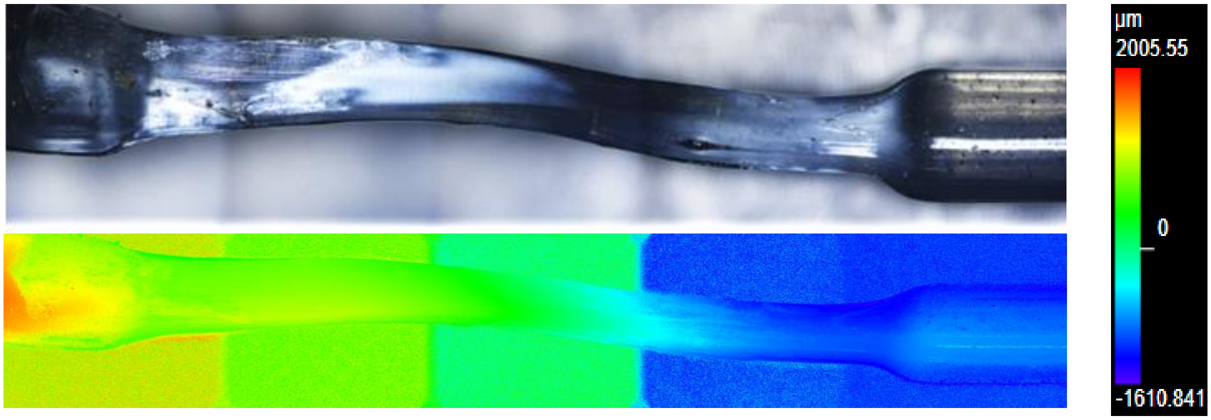


Figure S1. Laser microscope (x10) of the neck formation in the PP filament during the tensile test.

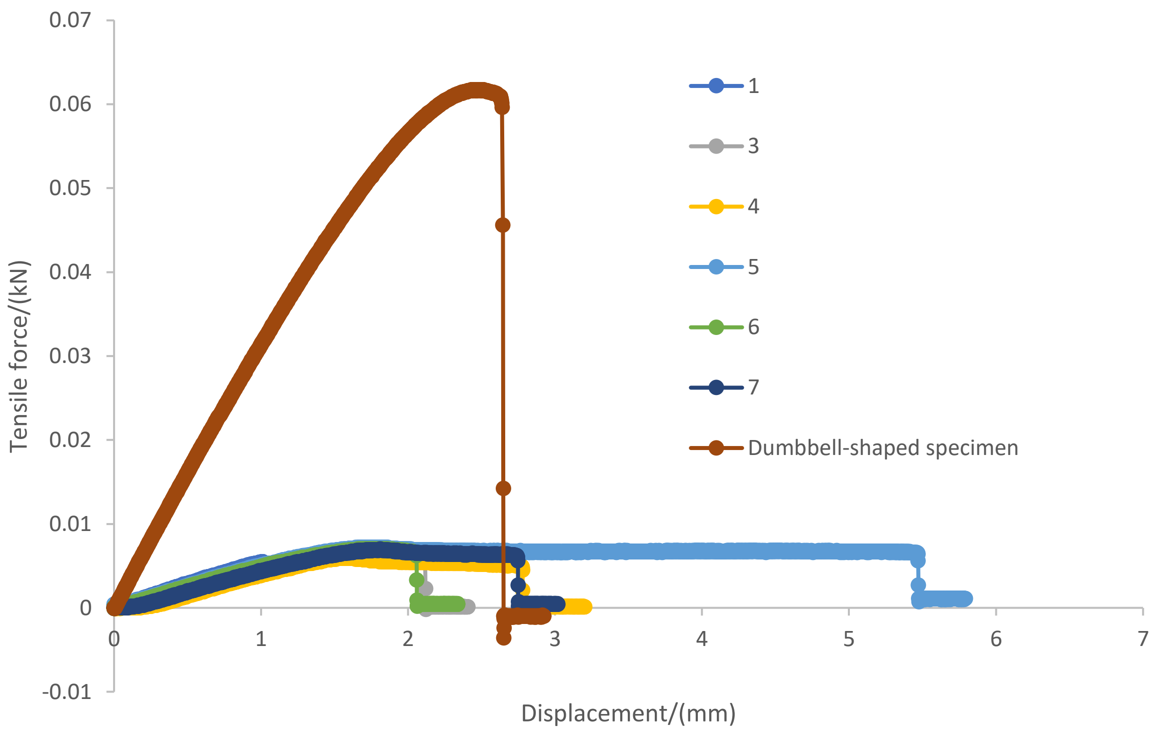


Figure S2. Profile tensile force vs extension of the white ABS filament and the dumbbell shaped specimen prepared following the British Standard EN ISO 527-2:2012 (test conditions for molding and extrusion).

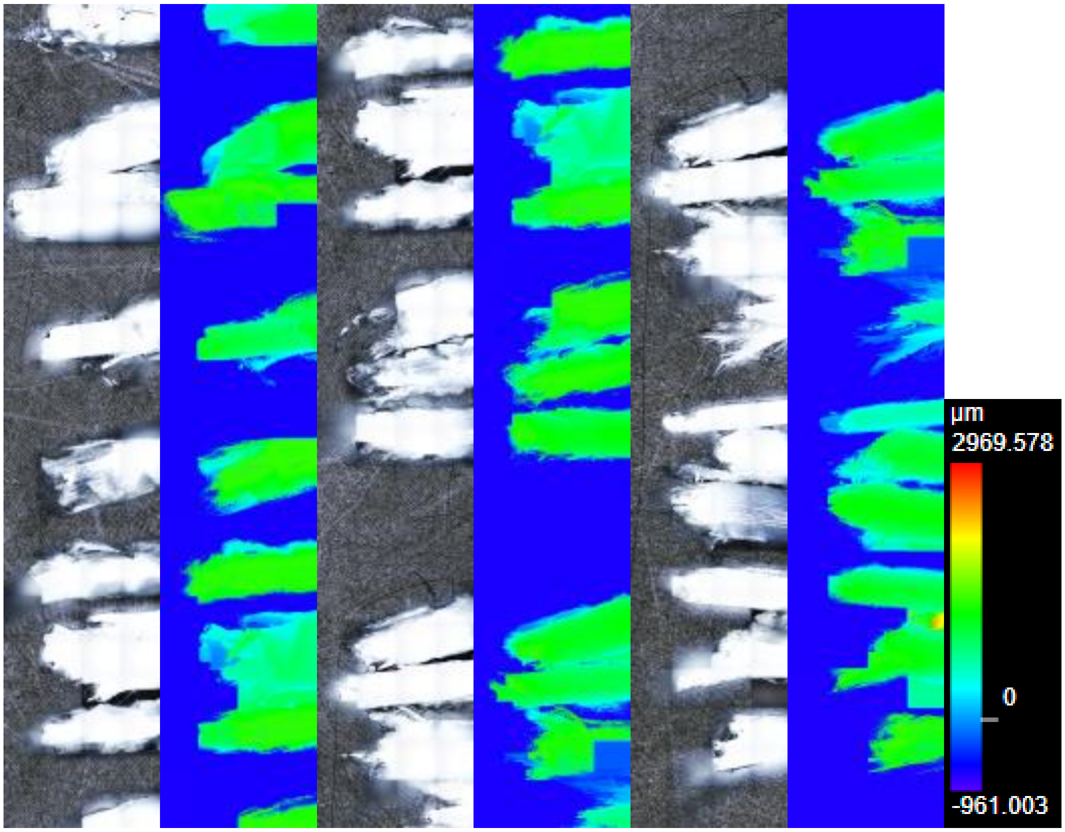


Figure S3. Lose threads that can be seen in the filament made of 50 % virgin HDPE and 50 % virgin ABS upon rupture in the tensile testing.

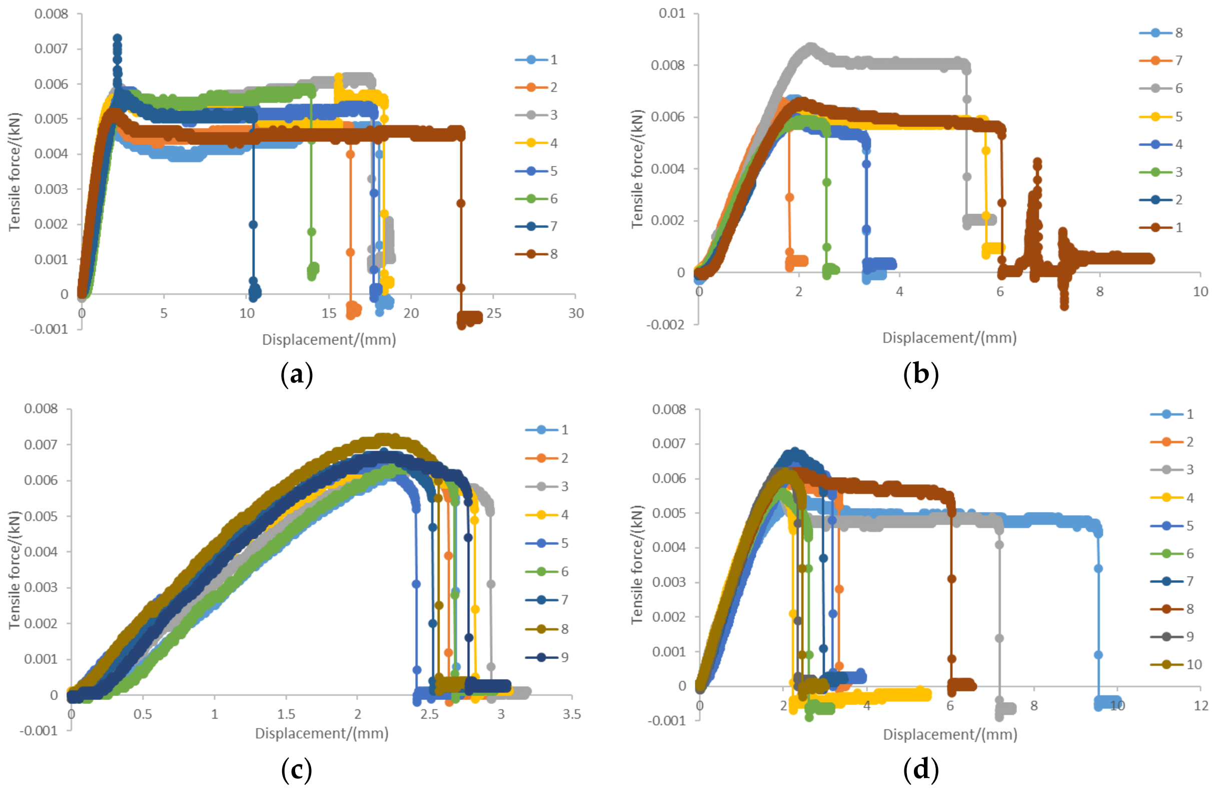


Figure S4. Tensile testing profiles for: (**a**) Commercial black ABS (8 replicates), (**b**) acetone smoothen white ABS (8 replicates), (**c**) virgin ABS (9 replicates), and (**d**) 10% white ABS + 90 % virgin ABS (10 replicates).

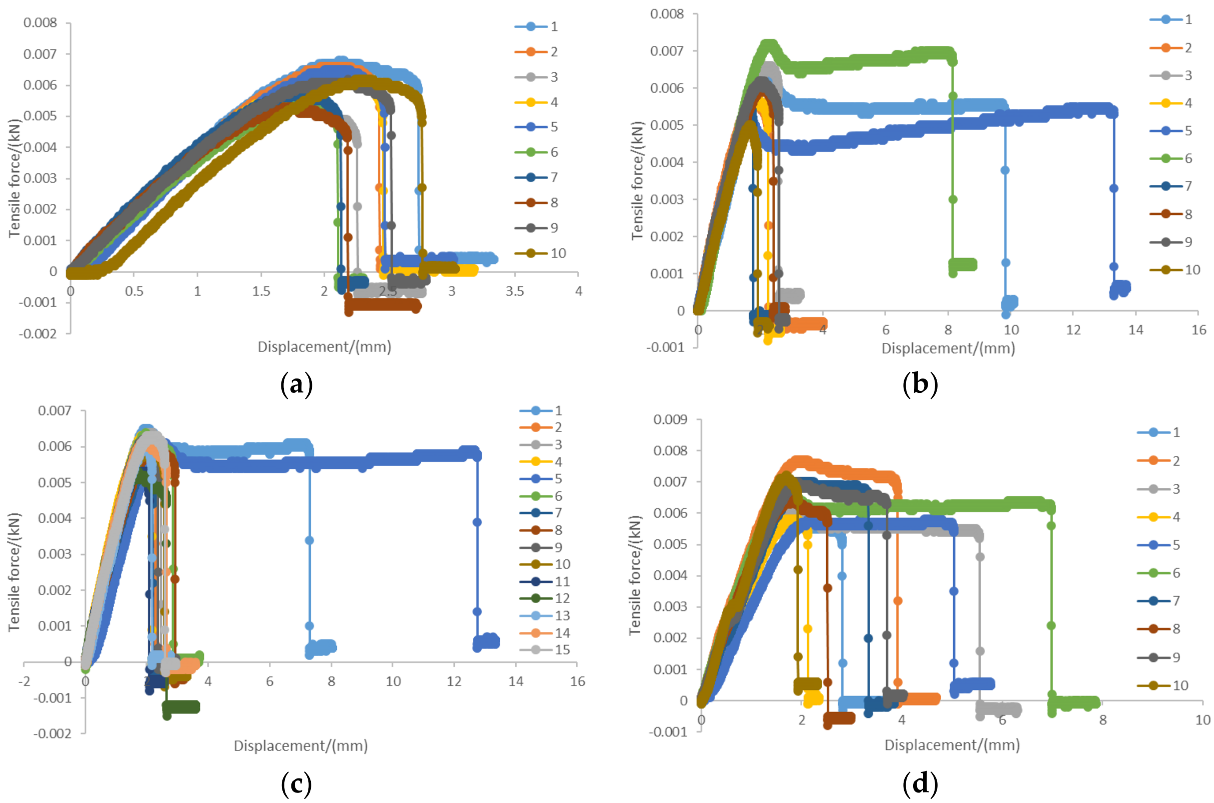


Figure S5. Tensile testing profiles for: (**a**) 18 % white ABS + 82 % virgin ABS (10 replicates), (**b**) 35 % white ABS + 65 % virgin ABS (10 replicates), (**c**) 40 % white ABS + 60 % virgin ABS (15 replicates), and (**d**) 70 % white ABS + 30 % virgin ABS (10 replicates).

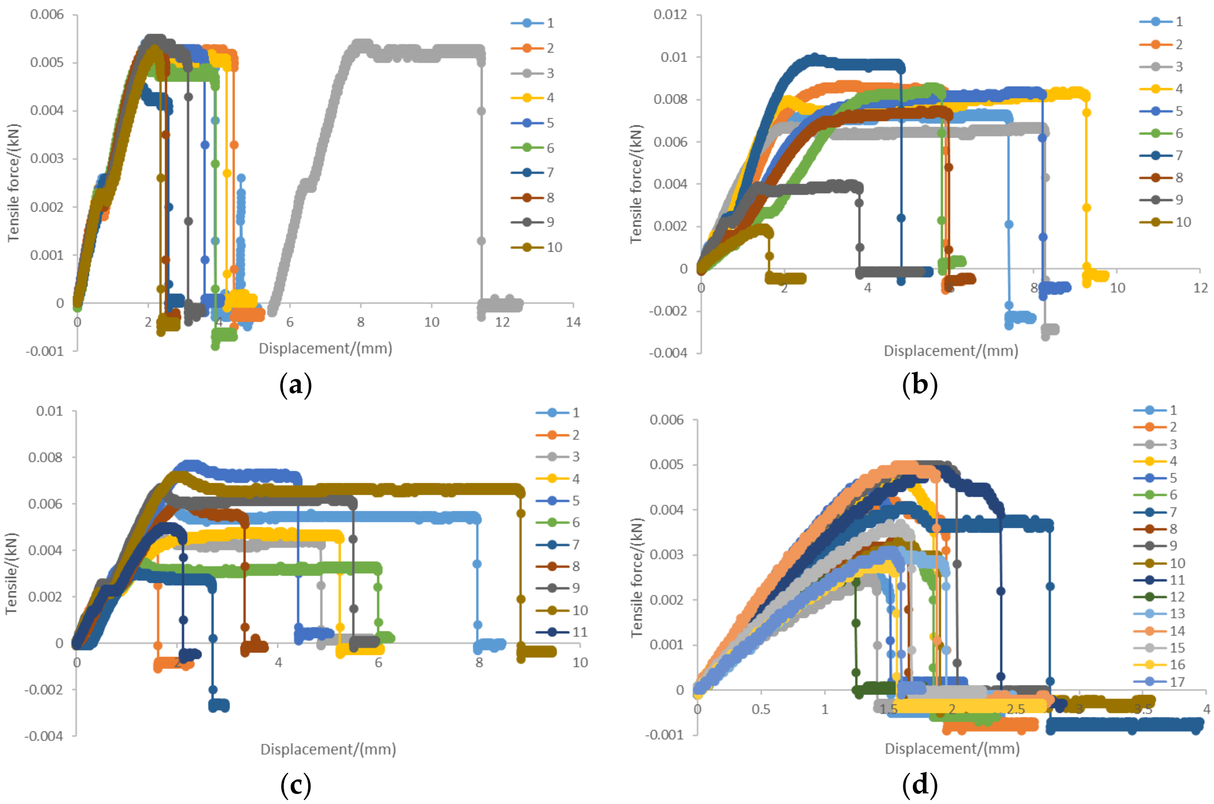


Figure S6. Tensile testing profiles for: (**a**) 90 % white ABS + 10 % virgin ABS (10 replicates), (**b**) clogging ABS (10 replicates), (**c**) 50 % white ABS + 50 % black ABS (11 replicates), and (**d**) 50 % ABS+PC + 50 % black ABS (17 replicates).

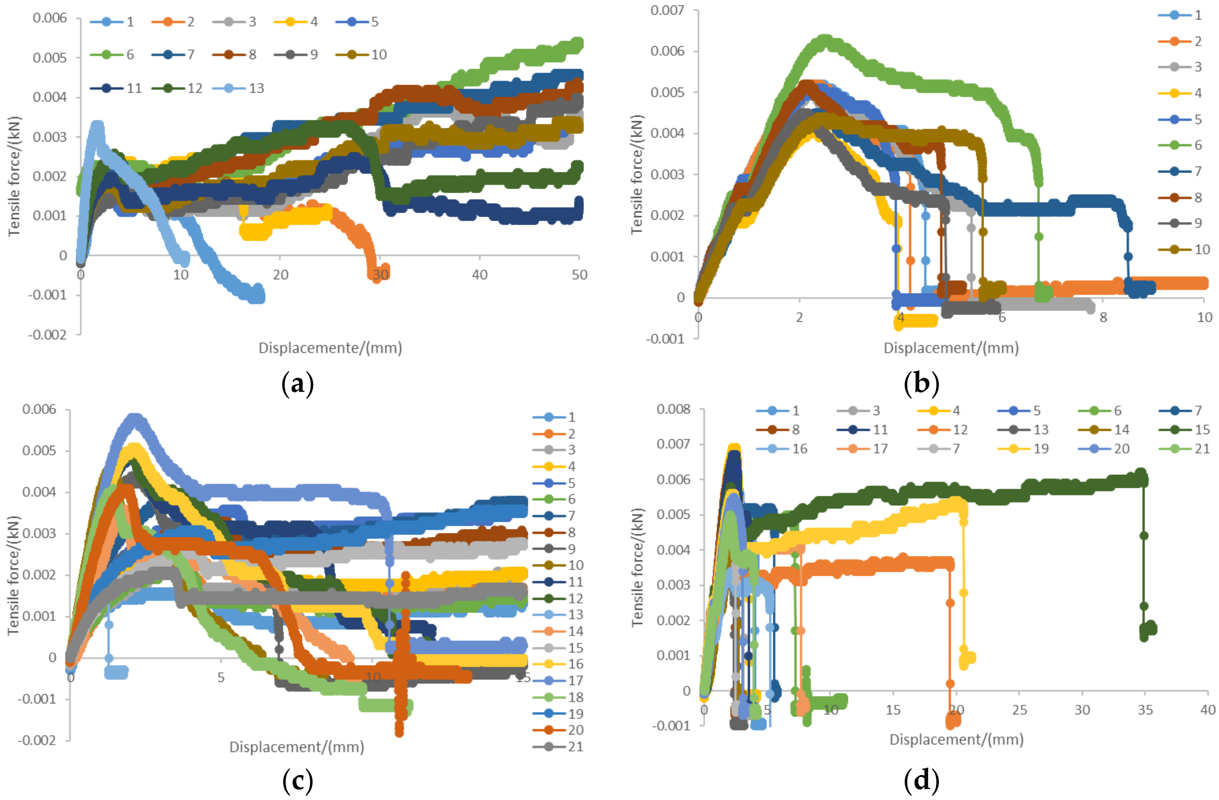
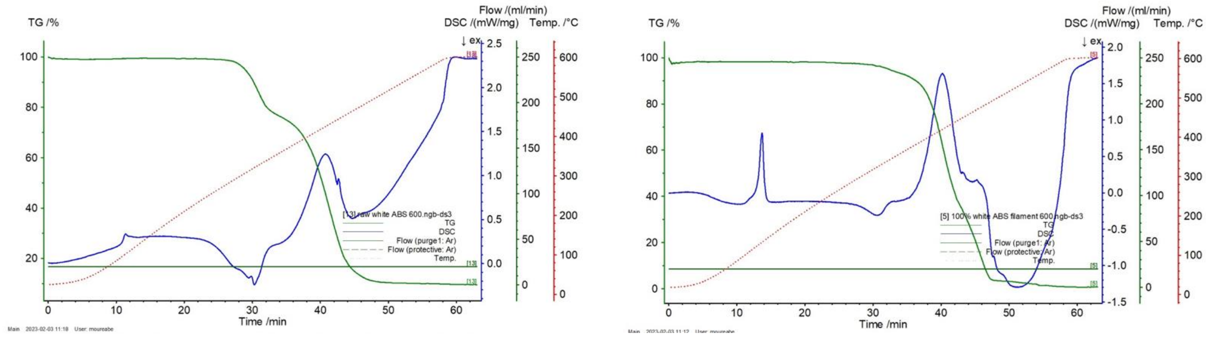
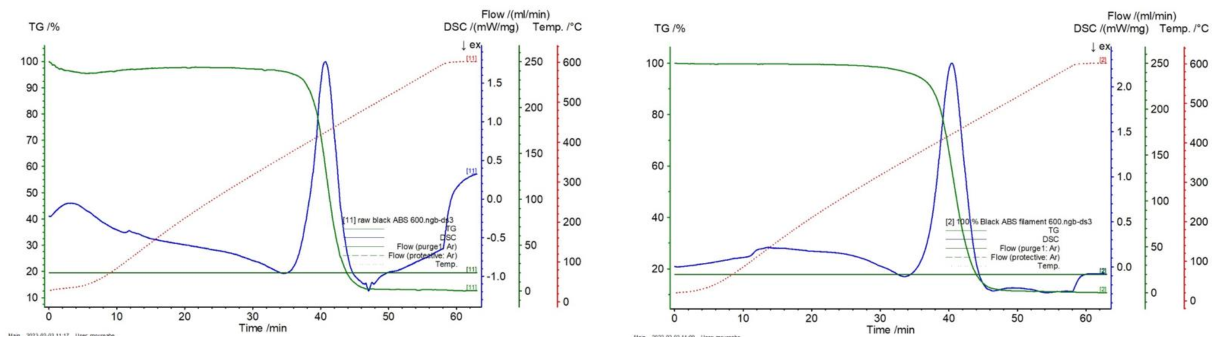


Figure S7. Tensile testing profiles for: (**a**) 50 % black ABS + 50 % HDPE (13 replicates), (**b**) 50 % virgin ABS + 50 % HDPE (10 replicates), (**c**) 50 % PP + 50 % PLA (21 replicates), and (**d**) 10 % PP + 90 % PLA (21 replicates).



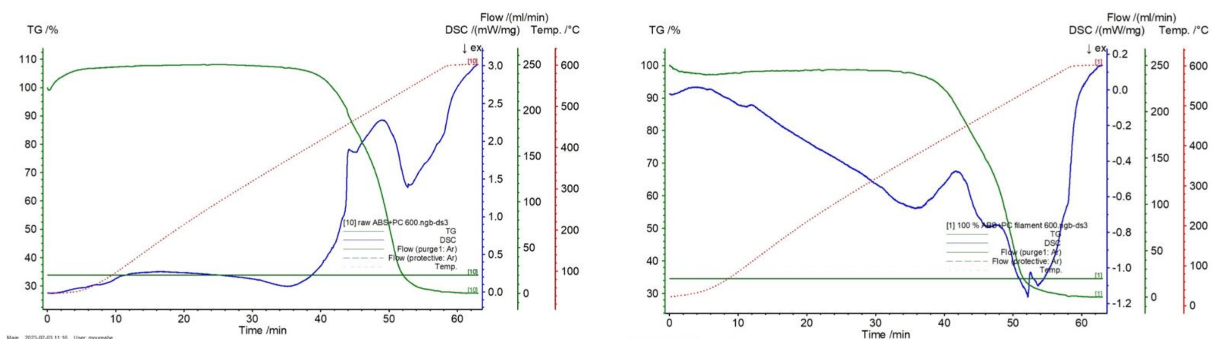
(**a**) (**b**)

Figure S8. Thermogravimetric analysis (green line) and differencing scanning calorimetry (blue line) performed up to 600 ºC (red line) for the white ABS: (**a**) unprocessed waste and (**b**) the 1.75-mm filament obtained with the melt-blend extrusion.



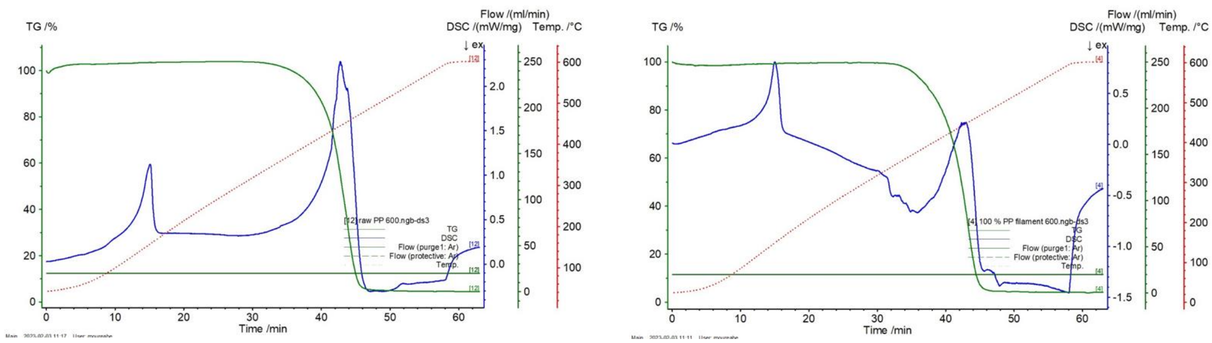
(**a**) (**b**)

Figure S9. Thermogravimetric analysis (green line) and differencing scanning calorimetry (blue line) performed up to 600 ºC (red line) for the black ABS: (**a**) unprocessed waste and (**b**) the 1.75-mm filament obtained with the melt-blend extrusion.



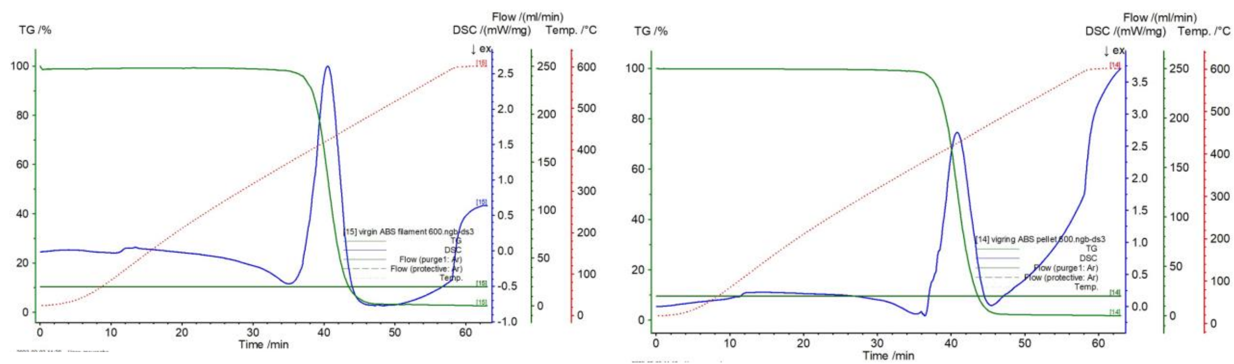
(**a**) (**b**)

Figure S10. Thermogravimetric analysis (green line) and differencing scanning calorimetry (blue line) performed up to 600 ºC (red line) for the ABS+PC: (**a**) unprocessed waste and in (**b**) the 1.75-mm filament obtained with the melt-blend extrusion.



(**a**) (**b**)

Figure S11. Thermogravimetric analysis (green line) and differencing scanning calorimetry (blue line) performed up to 600 ºC (red line) for the PP: (**a**) unprocessed waste and in (**b**) the 1.75-mm filament obtained with the melt-blend extrusion.



(**a**) (**b**)

Figure S12. Thermogravimetric analysis (green line) and differencing scanning calorimetry (blue line) performed up to 600 ºC (red line) for the virgin ABS: (**a**) unprocessed pellet and in (**b**) the 1.75-mm filament obtained with the melt-blend extrusion.

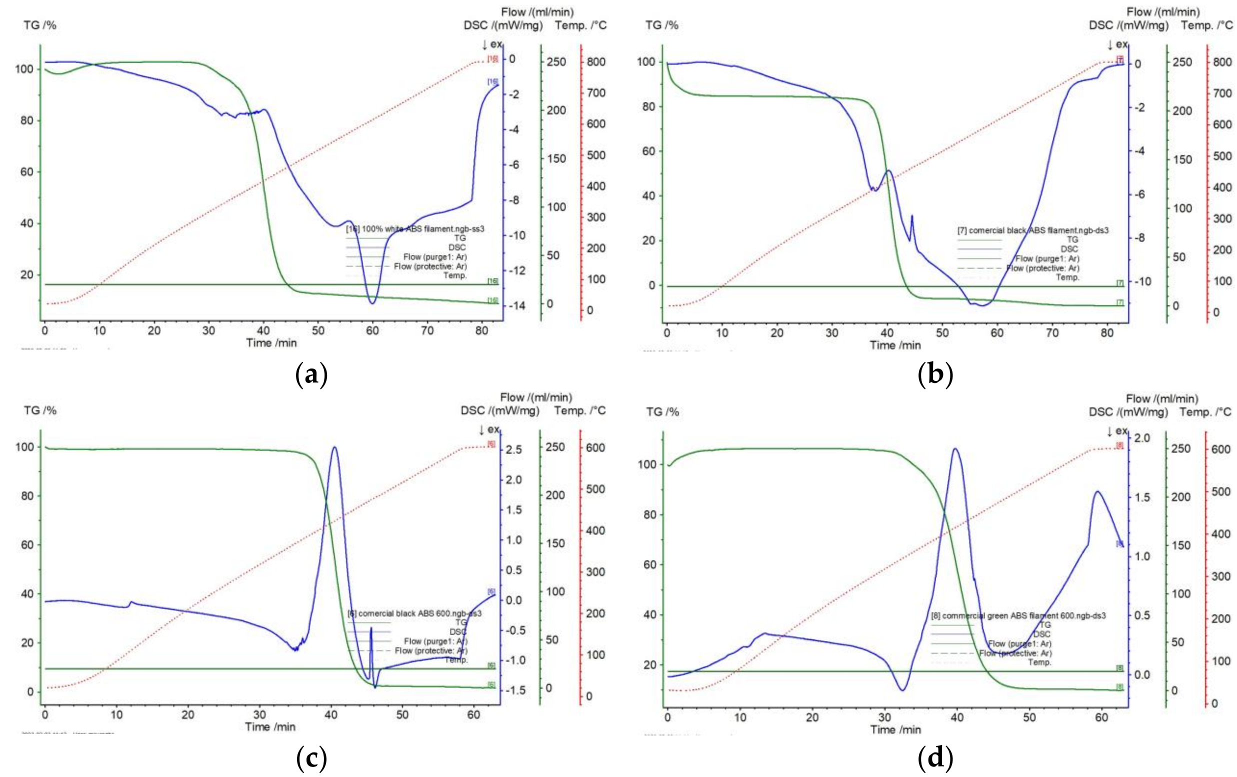


Figure S13. Thermogravimetric analysis (green line) and differencing scanning calorimetry (blue line) performed at the temperature informed by the red line for: (**a**) white ABS filament @ 800 ºC; (**b**) commercial black ABS filament @ 800 ºC; (**c**) commercial black ABS filament @ 600 ºC; (**d**) commercial green ABS @ 600 ºC.

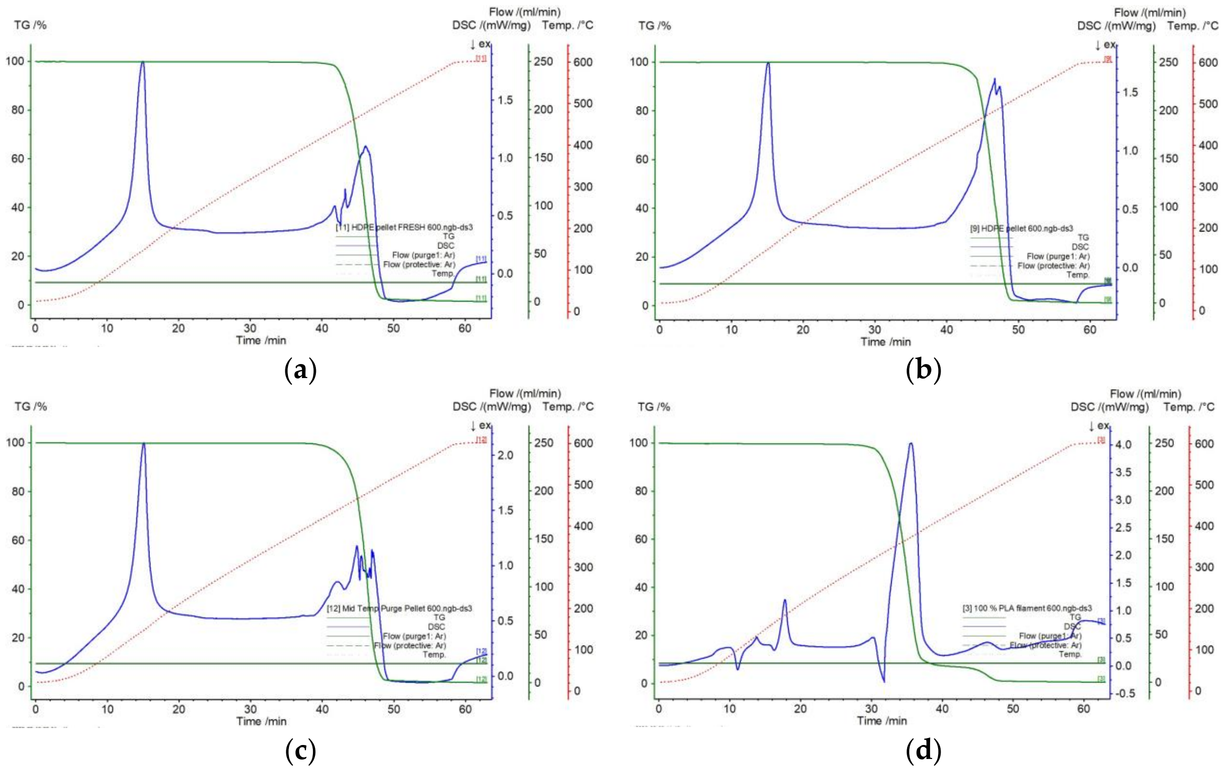


Figure S14. Thermogravimetric analysis (green line) and differencing scanning calorimetry (blue line) performed up to 600 ºC (red line) for: (**a**) fresh HDPE; (**b**) HDPE stored at room condition for a year; (**c**) MidTemp purge; (**d**) PLA filament.

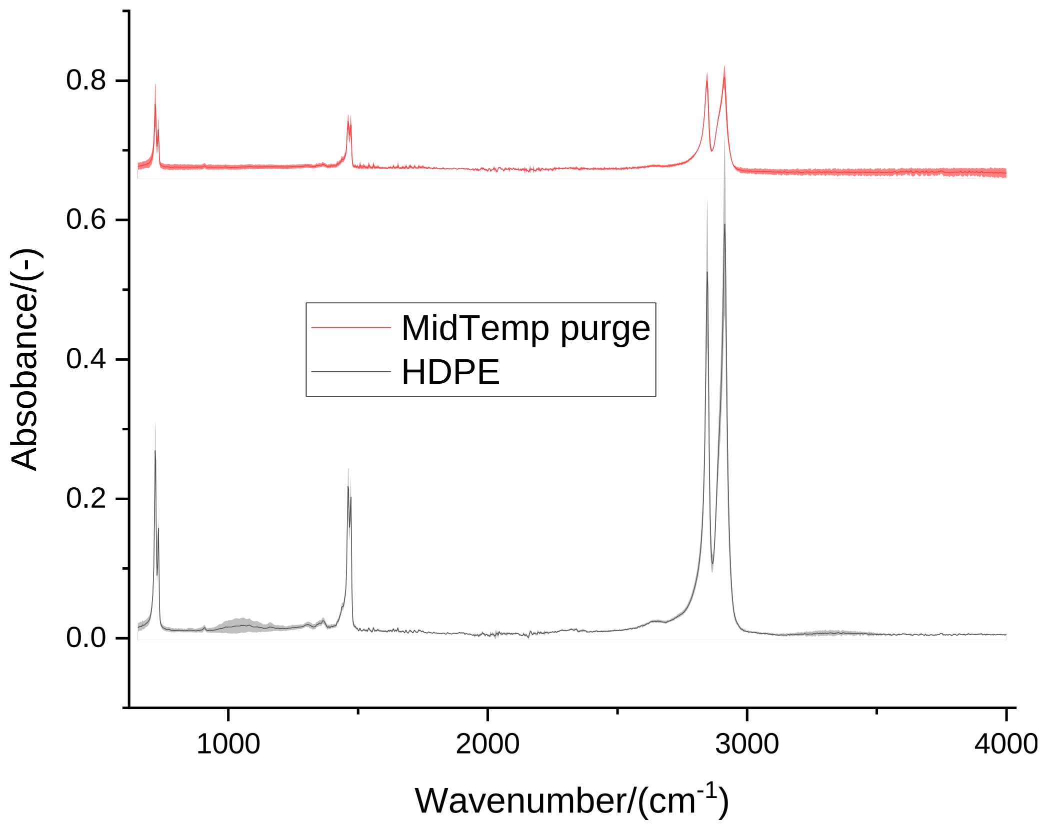


Figure S15. Comparisons of the FTIR spectra of the HDPE and the Devoclean MidTemp purge.

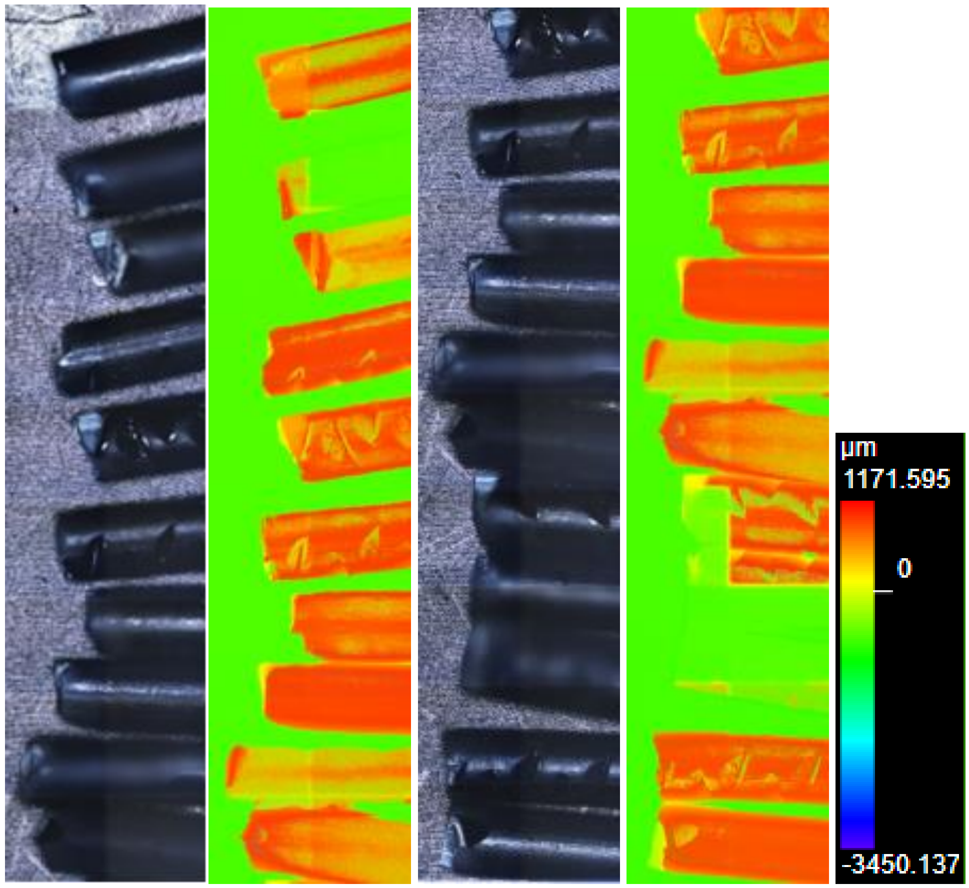


Figure S16. Laser microscope images (x5) of the rupture of the filaments of Commercial black ABS filament in the tensile test.

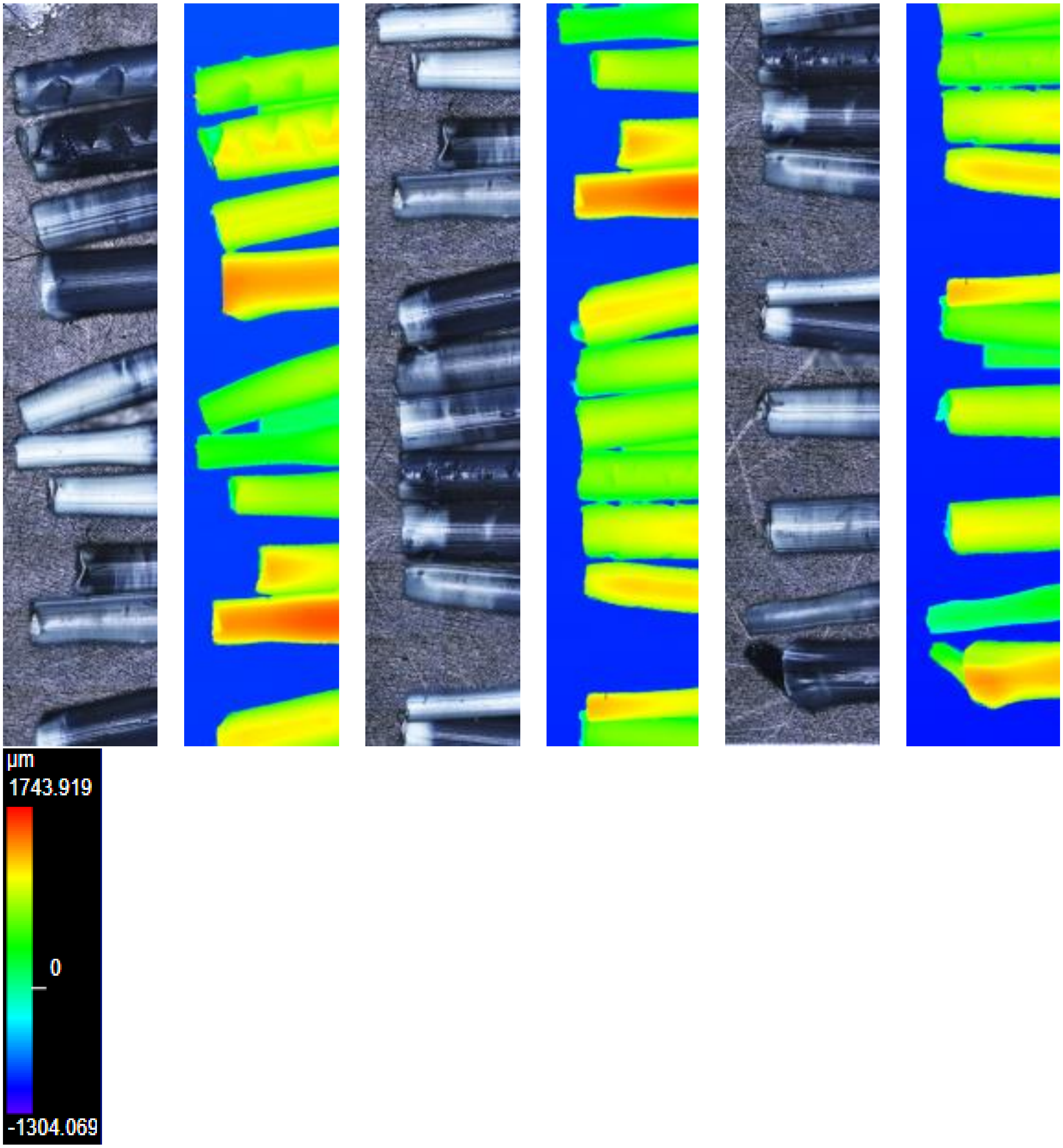


Figure S17. Laser microscope images (x5) of the failure of the filaments of 50 % white ABS 50 % Black ABS in the tensile test.

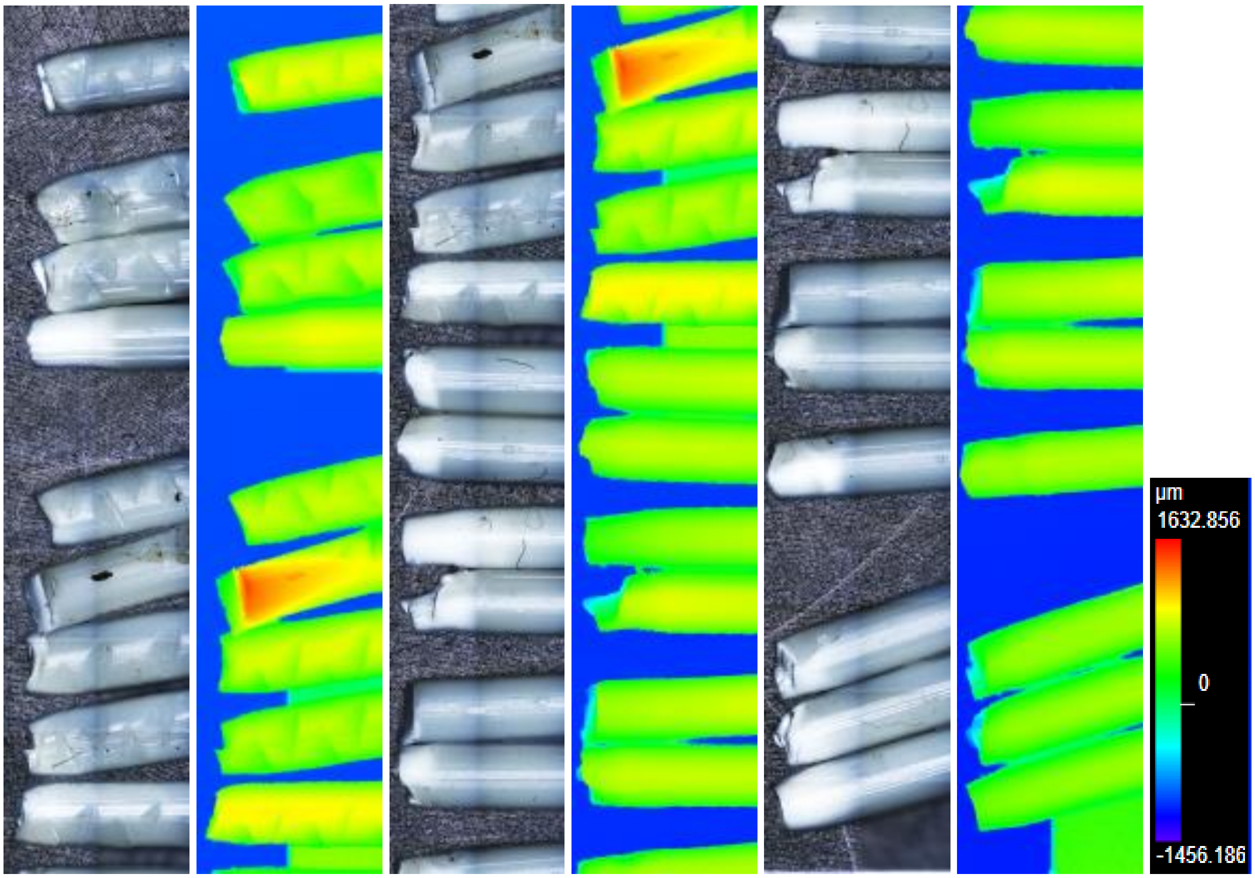


Figure S18. Laser microscope images (x5) of the failure of the filaments of10 % white ABS 90 % virgin ABS in the tensile test.

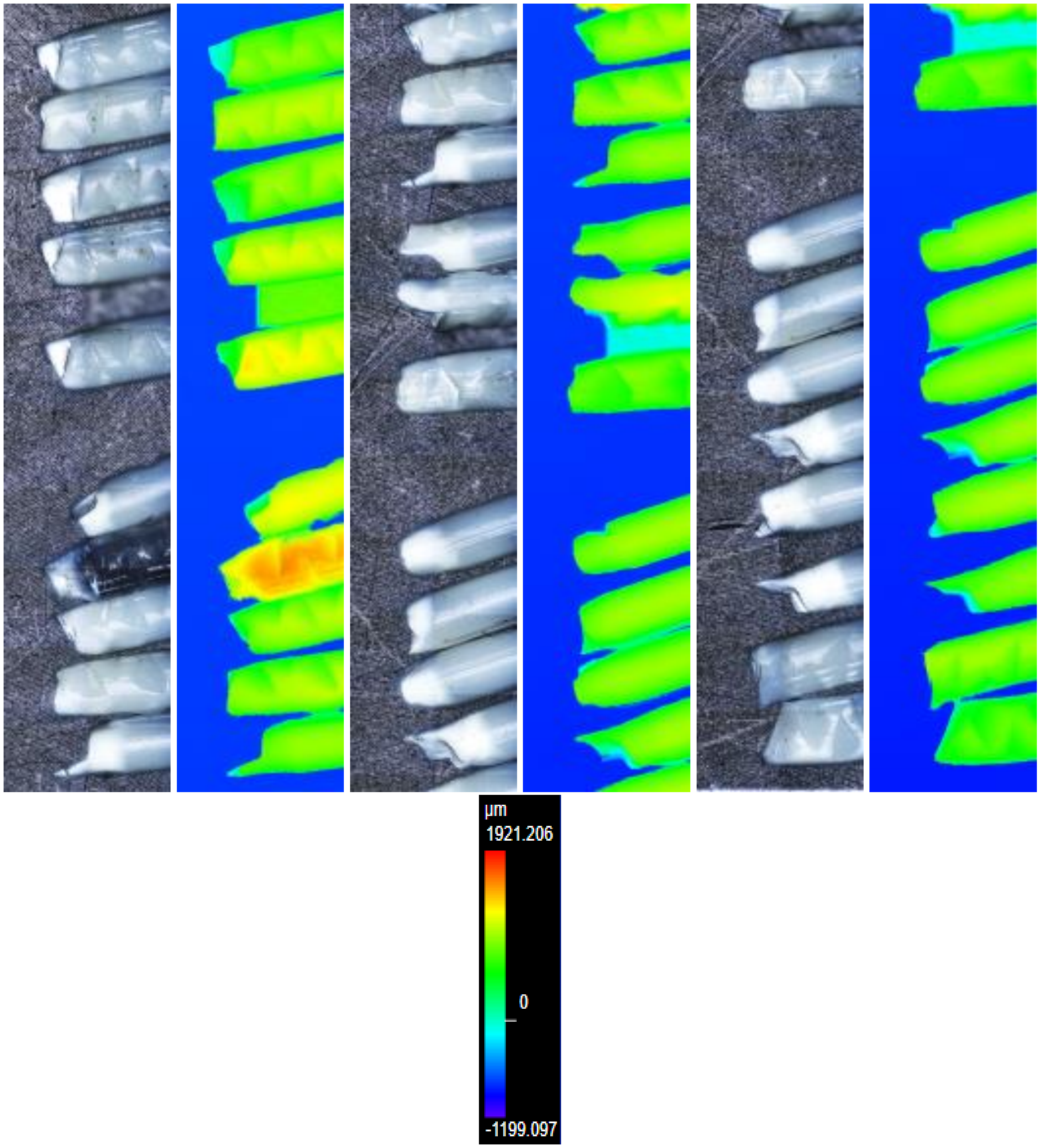


Figure S19. Laser microscope images (x5) of the rupture of the filaments of 18 % white ABS 88 % virgin ABS in the tensile test.

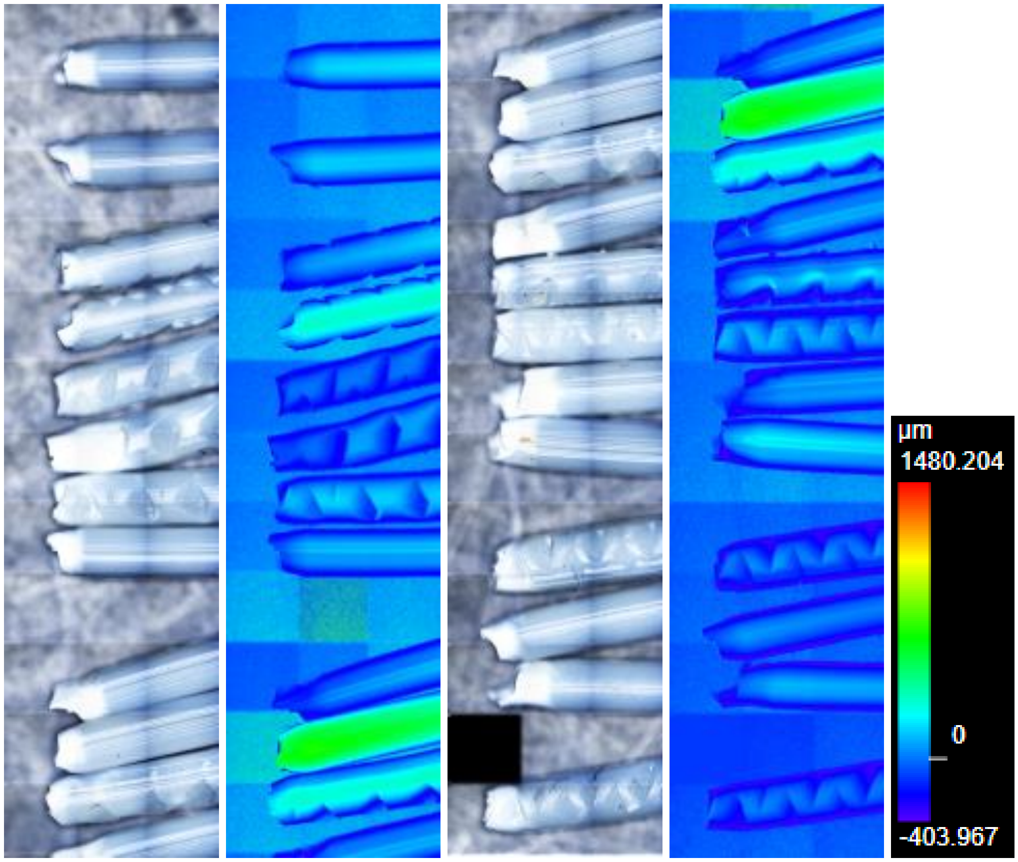


Figure S20. Laser microscope images (x5) of the failure of the filaments of 25 % white ABS 75 % virgin ABS in the tensile test.

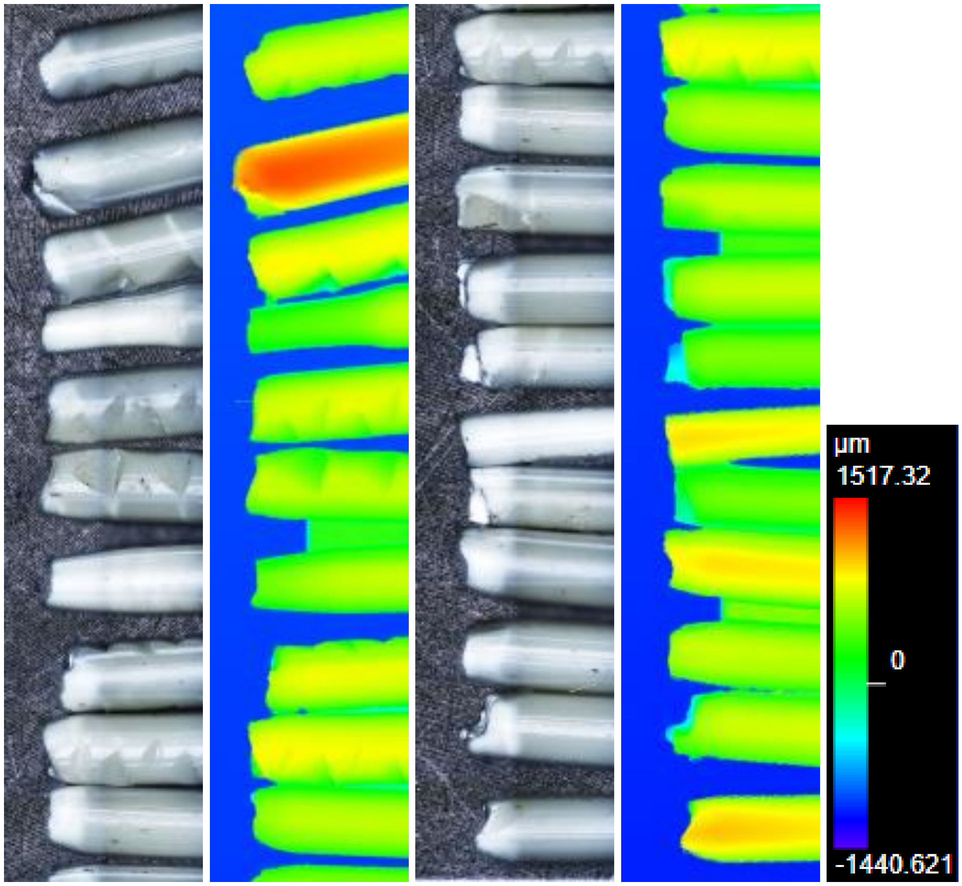


Figure S21. Laser microscope images (x5) of the failure of the filaments of 35 % white ABS 65 % virgin ABS in the tensile test.

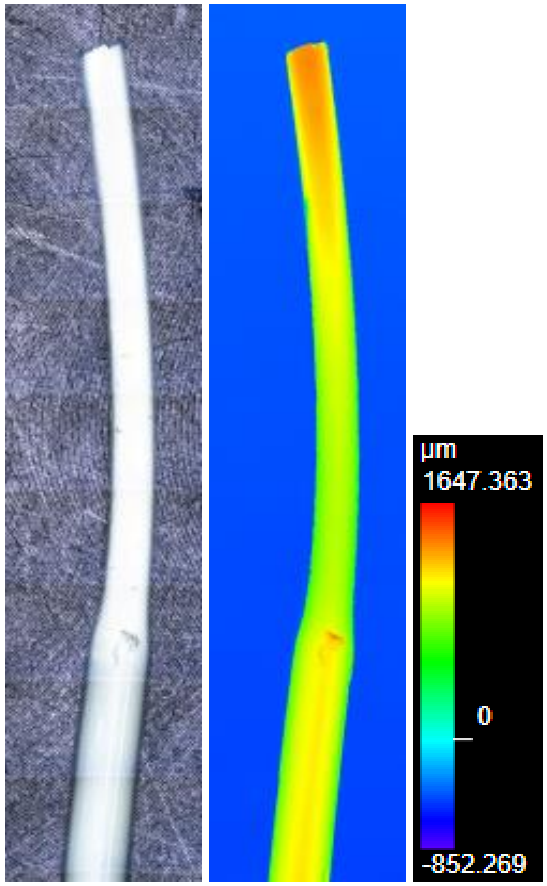


Figure S22. Neck formation in the filaments of 35 % white ABS 65 % virgin ABS during the tensile test.

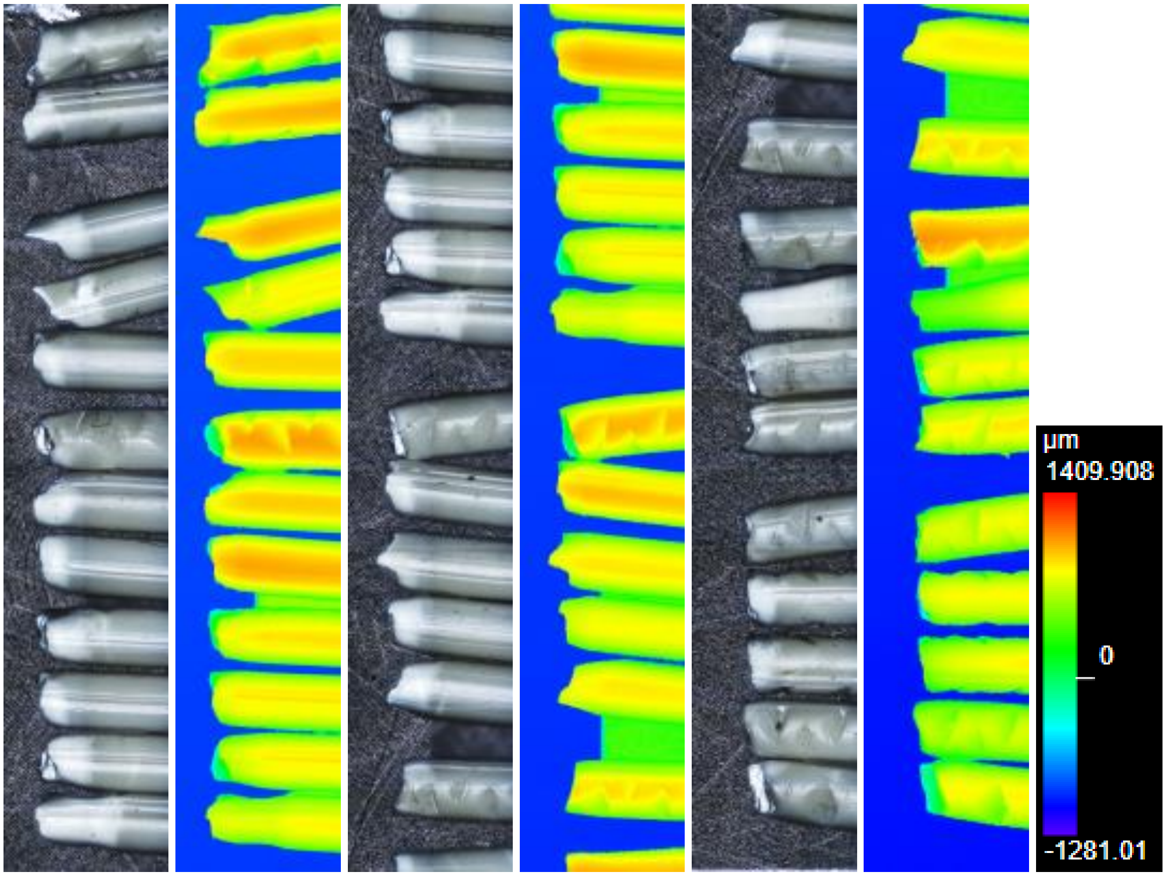


Figure S23. Laser microscope images (x5) of the rupture of the filaments of 40 % white ABS 60 % virgin ABS in the tensile test.

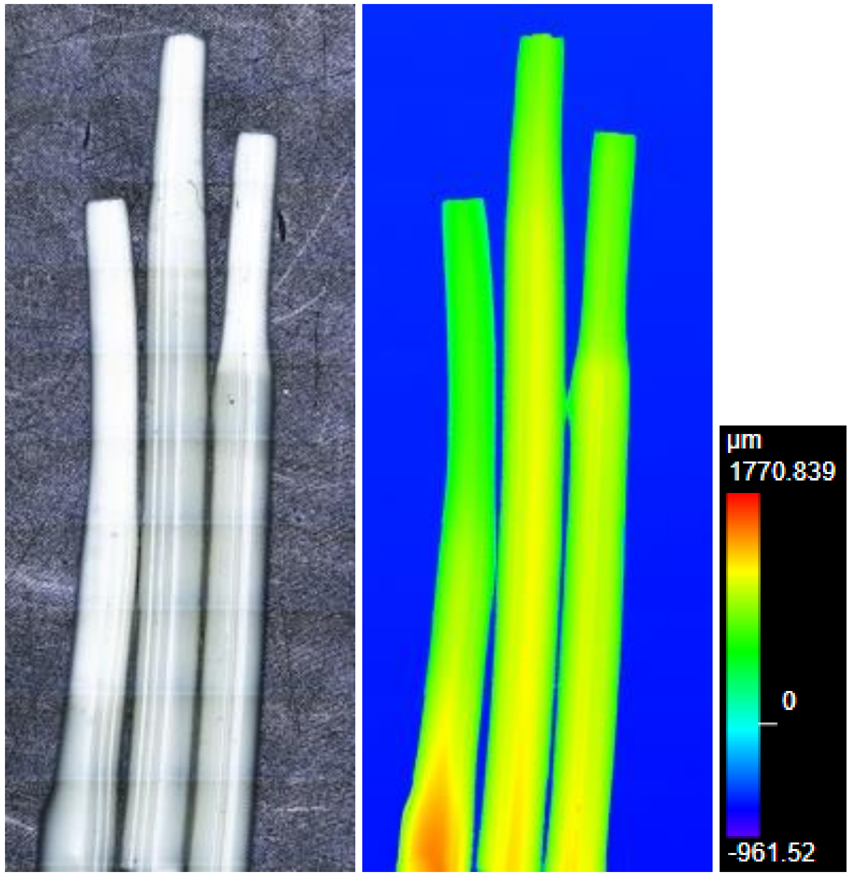


Figure S24. Neck formation in the filaments of 40 % white ABS 60 % virgin ABS in the tensile test.

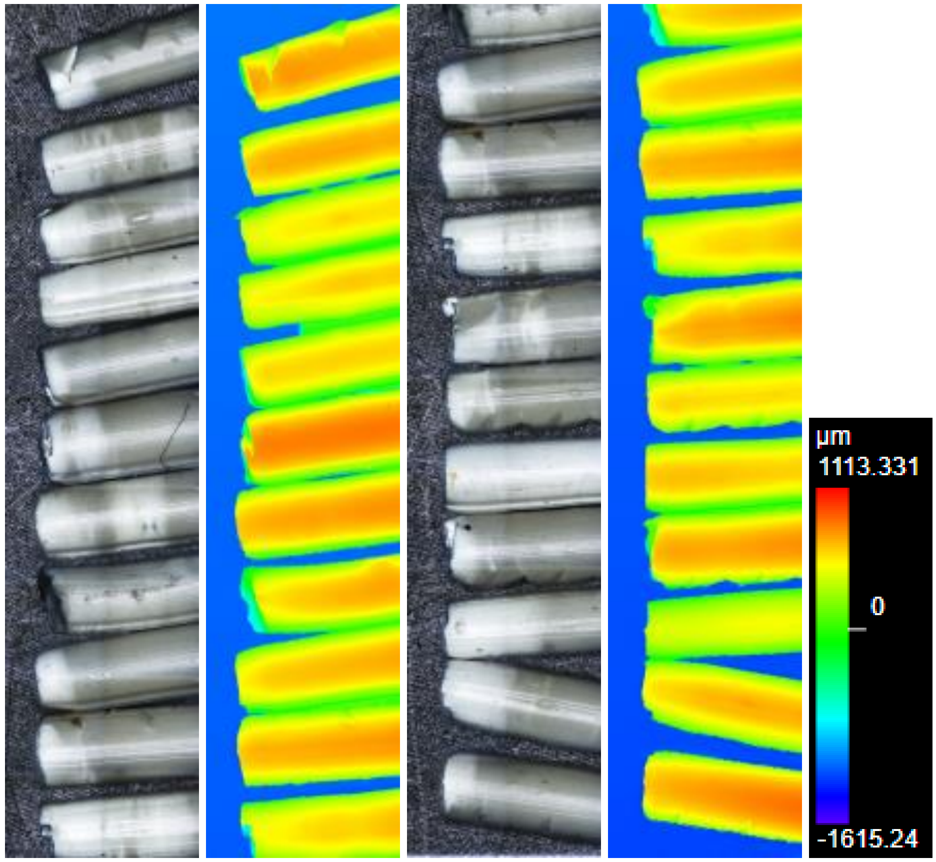


Figure S25. Laser microscope images (x5) of the rupture of the filaments of 70 % white ABS 30 % virgin ABS in the tensile test.

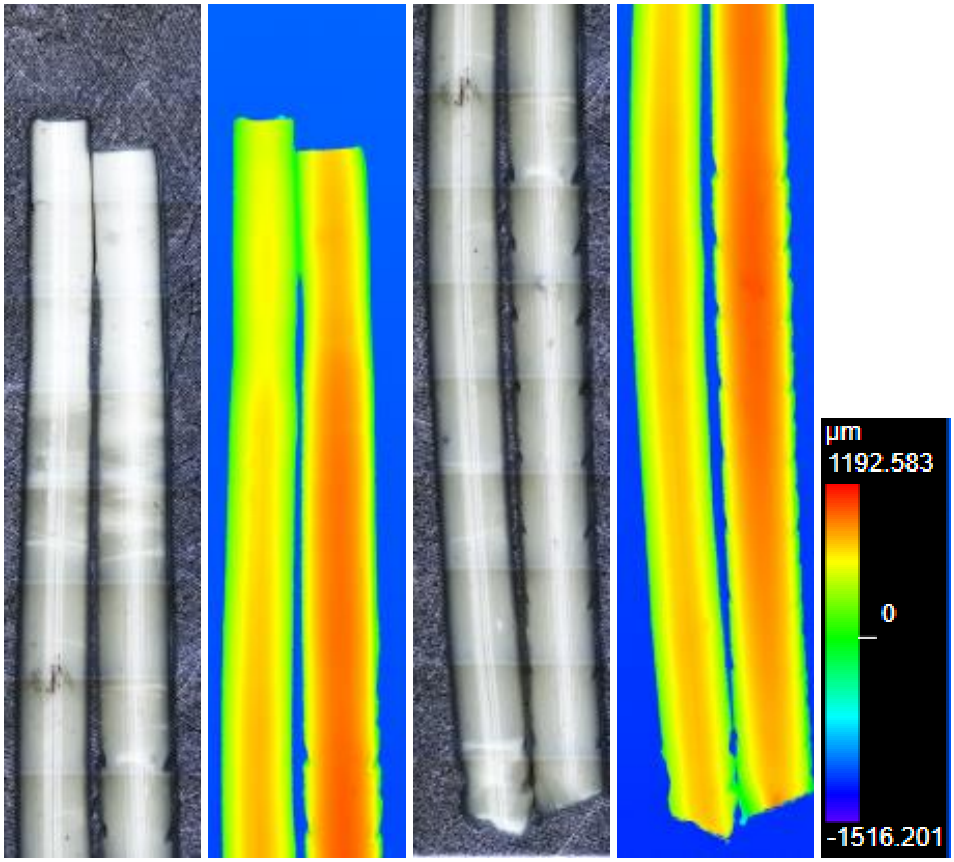


Figure S26. Laser microscope images (x5) of the failure of the filaments of 70 % white ABS 30 % virgin ABS in the tensile test.

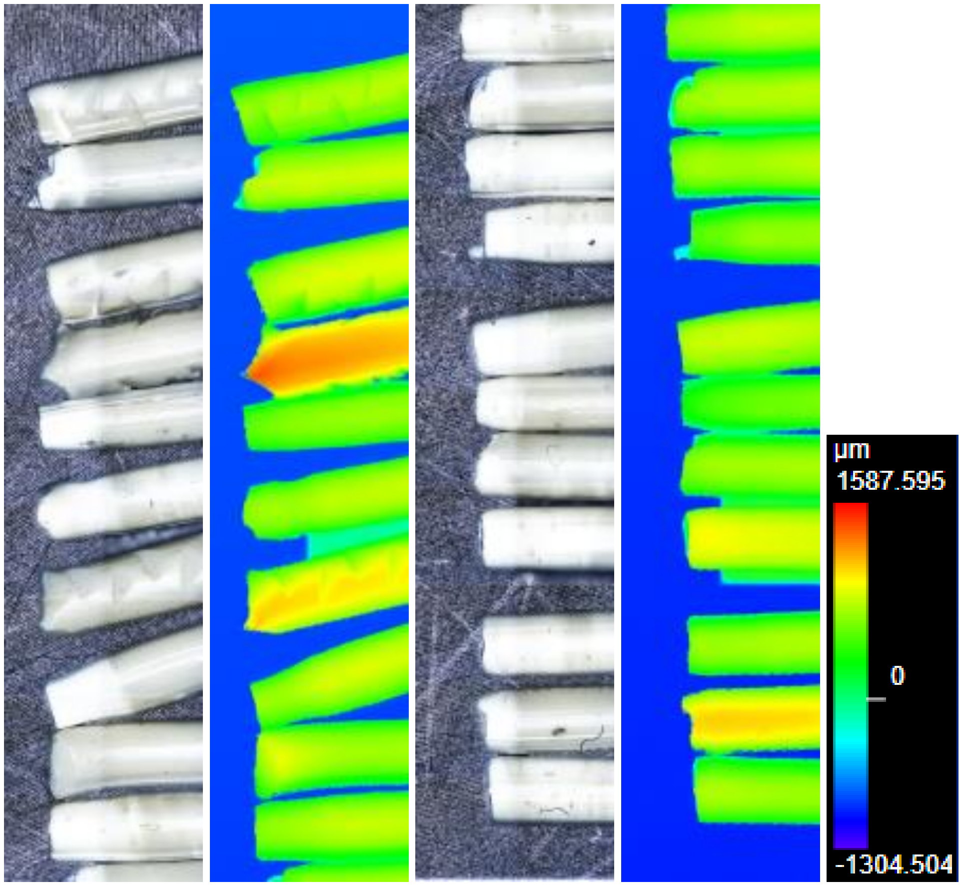


Figure S27. Laser microscope images (x5) of the rupture of the filaments of 90 % white ABS 10 % virgin ABS in the tensile test.

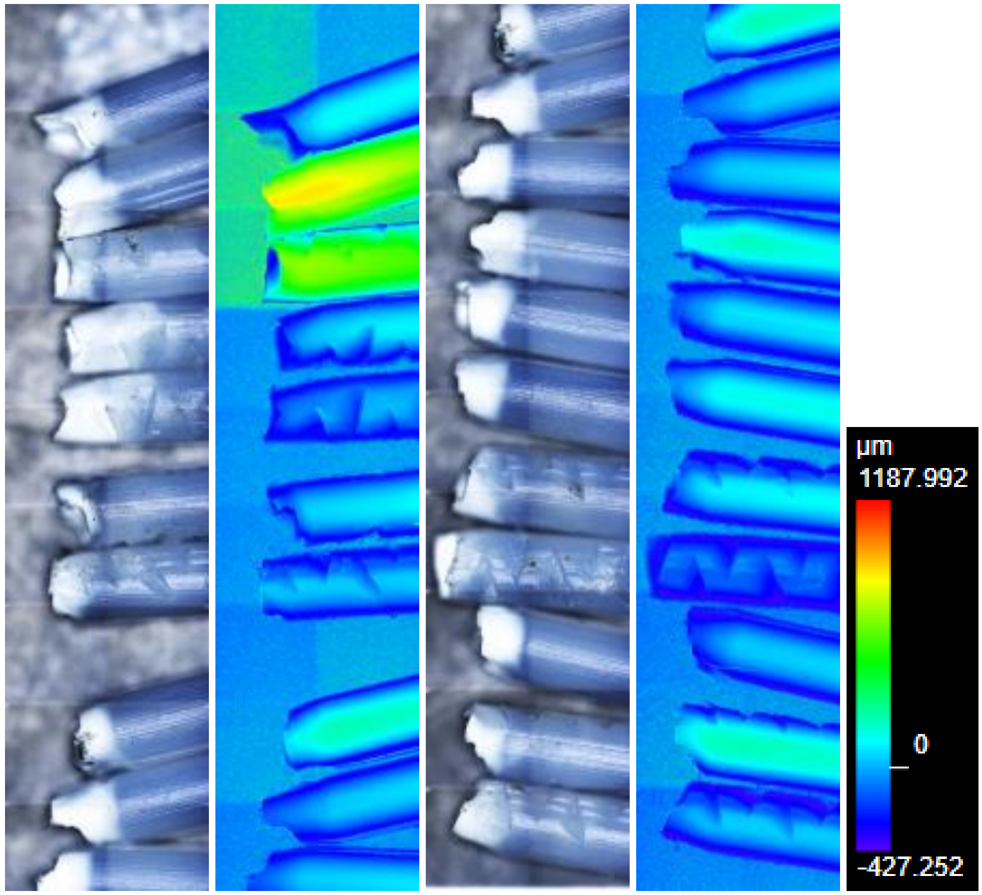


Figure S28. Laser microscope images (x5) of the failure of the filaments of virgin ABS in the tensile test.

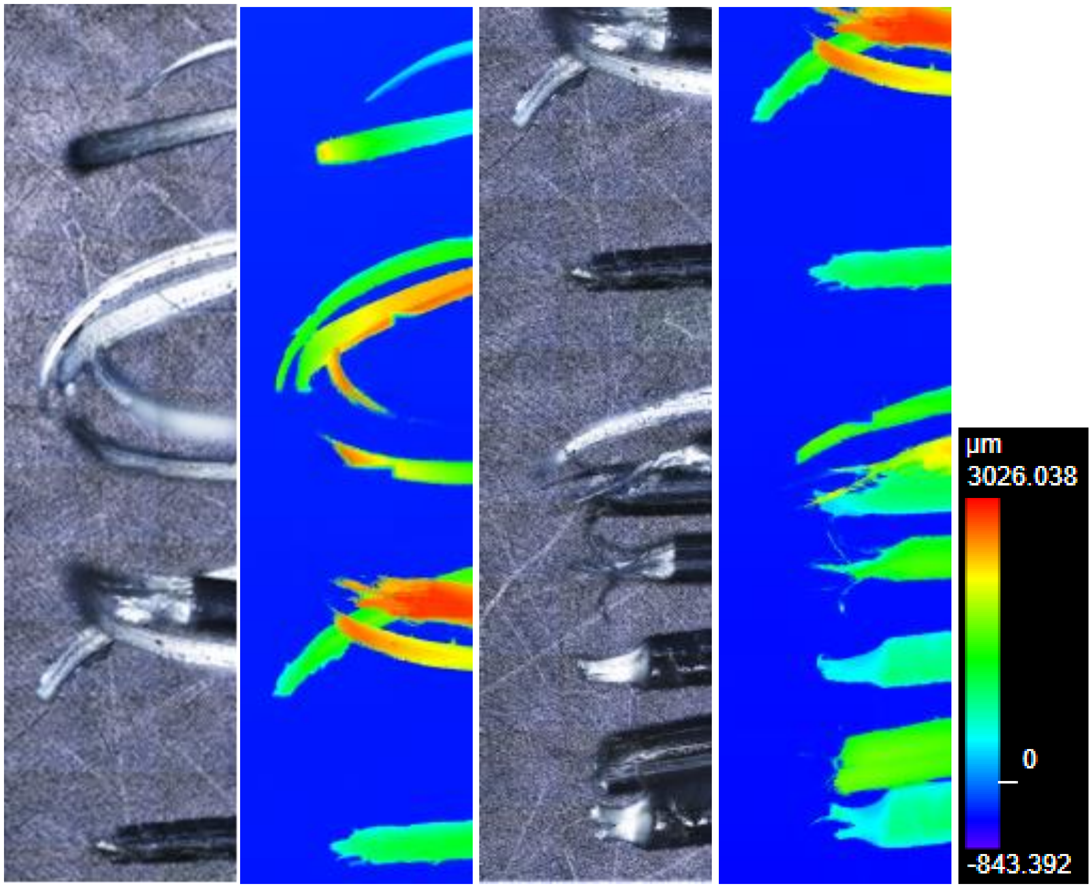


Figure S29. Laser microscope images (x5) of the rupture of the filaments of 50 % HDPE and 50 % Black ABS in the tensile test.

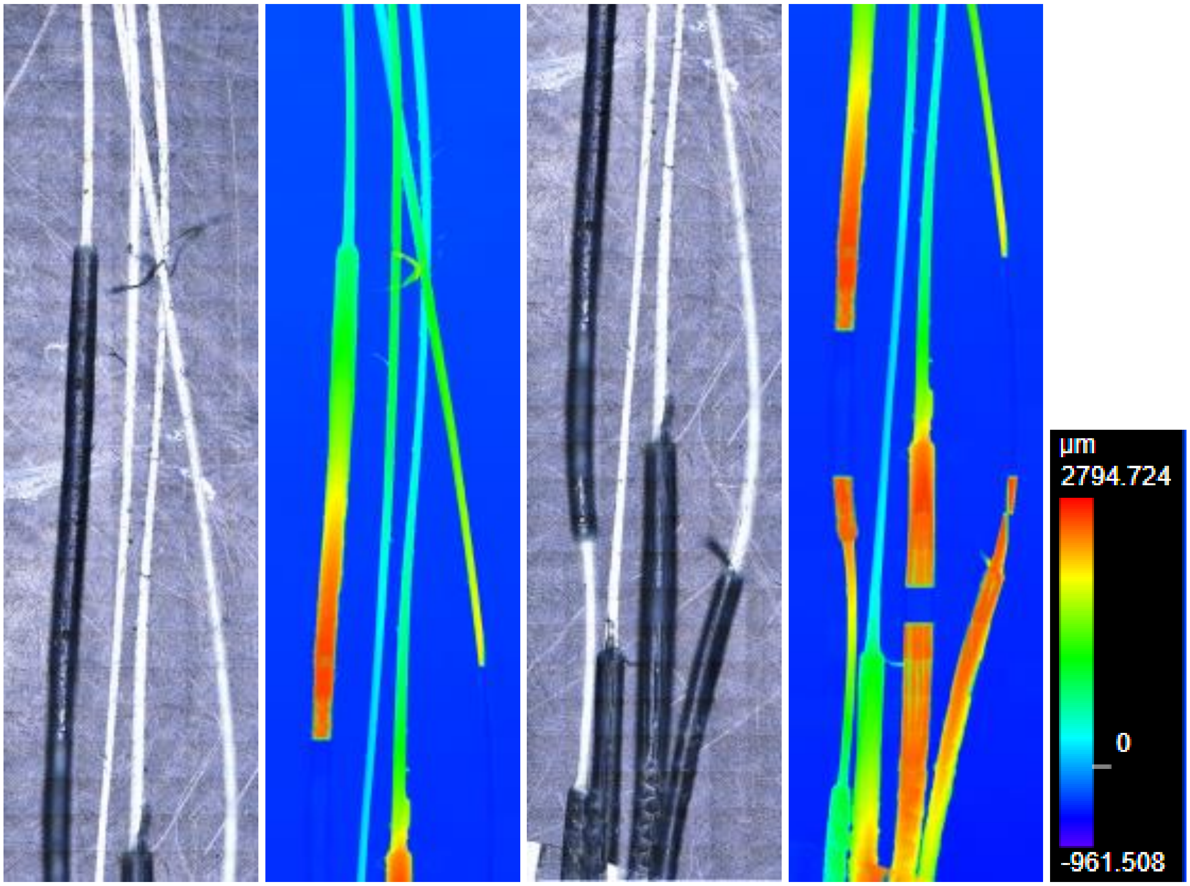


Figure S30. Laser microscope images (x5) of the failure of the filaments of 50 % HDPE 50 % Black ABS in the tensile test.

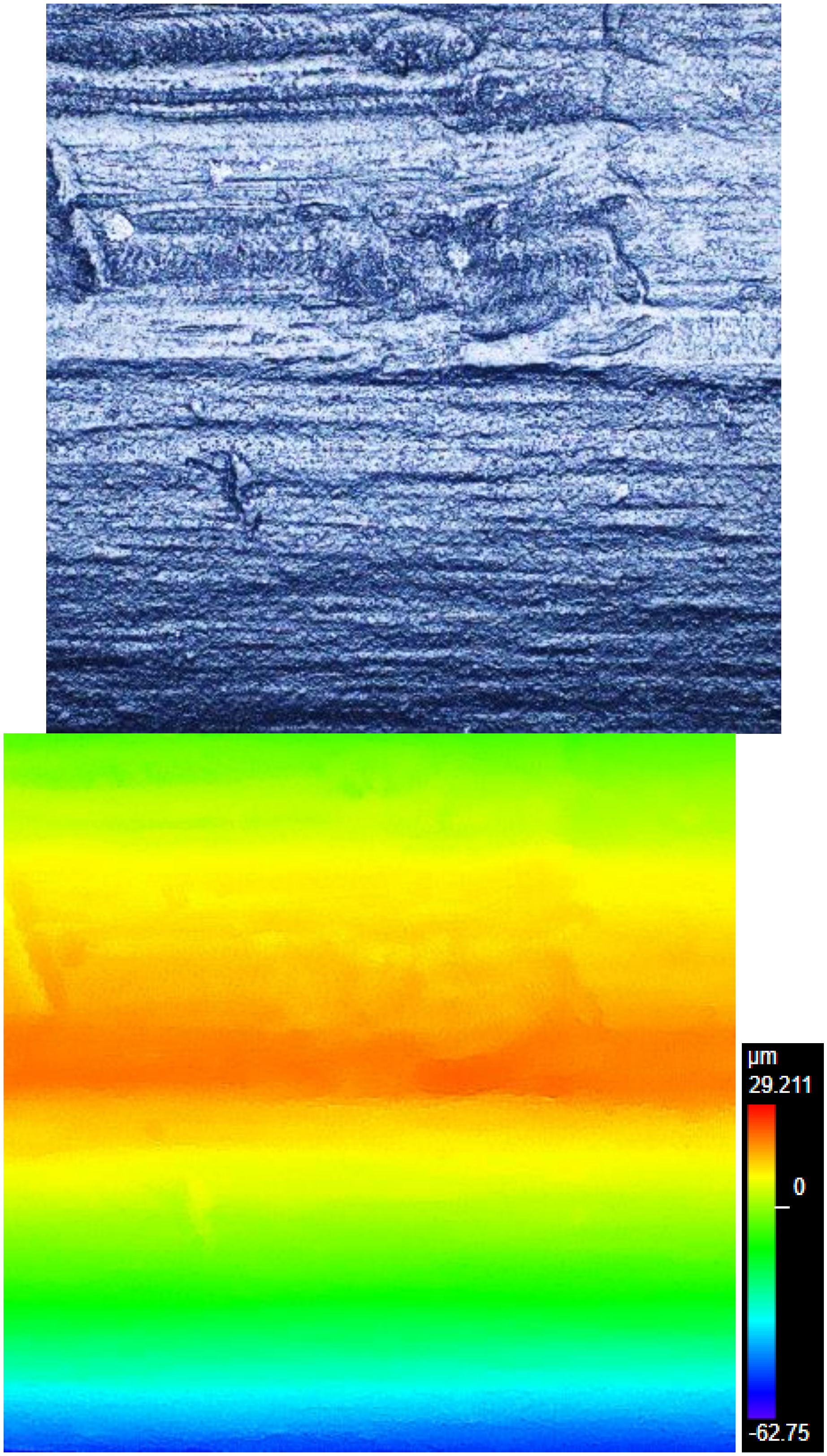


Figure S31. Laser microscope images (x5) of the rupture of the striations of the filament of ABS+PC.

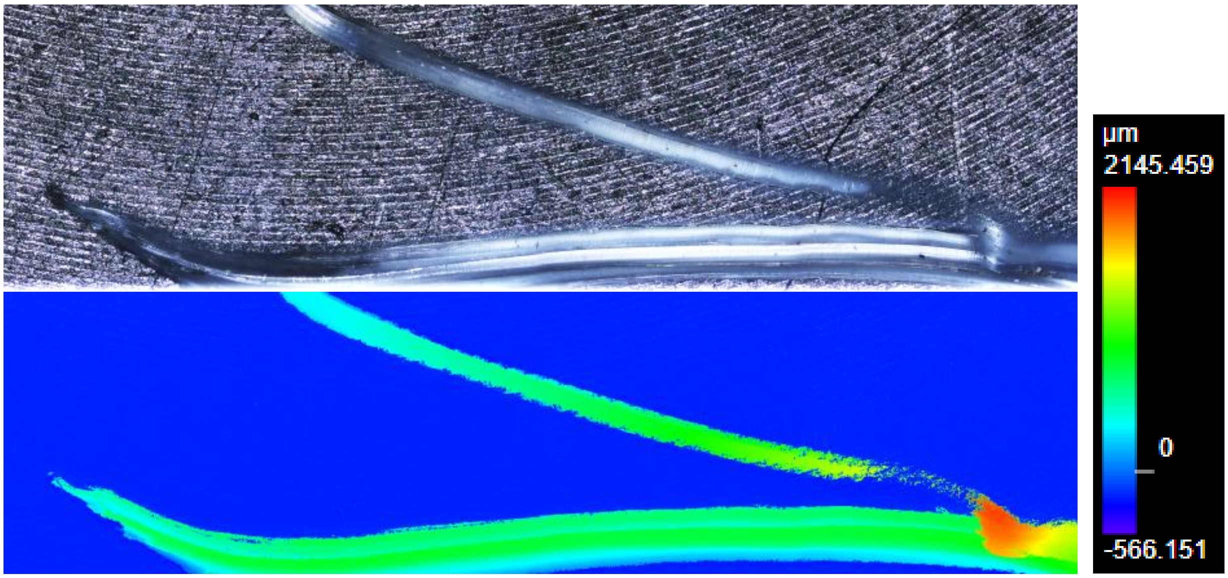


Figure S32. Laser microscope (x10) of the formation of 2 fibers in the PP filament during the tensile test.

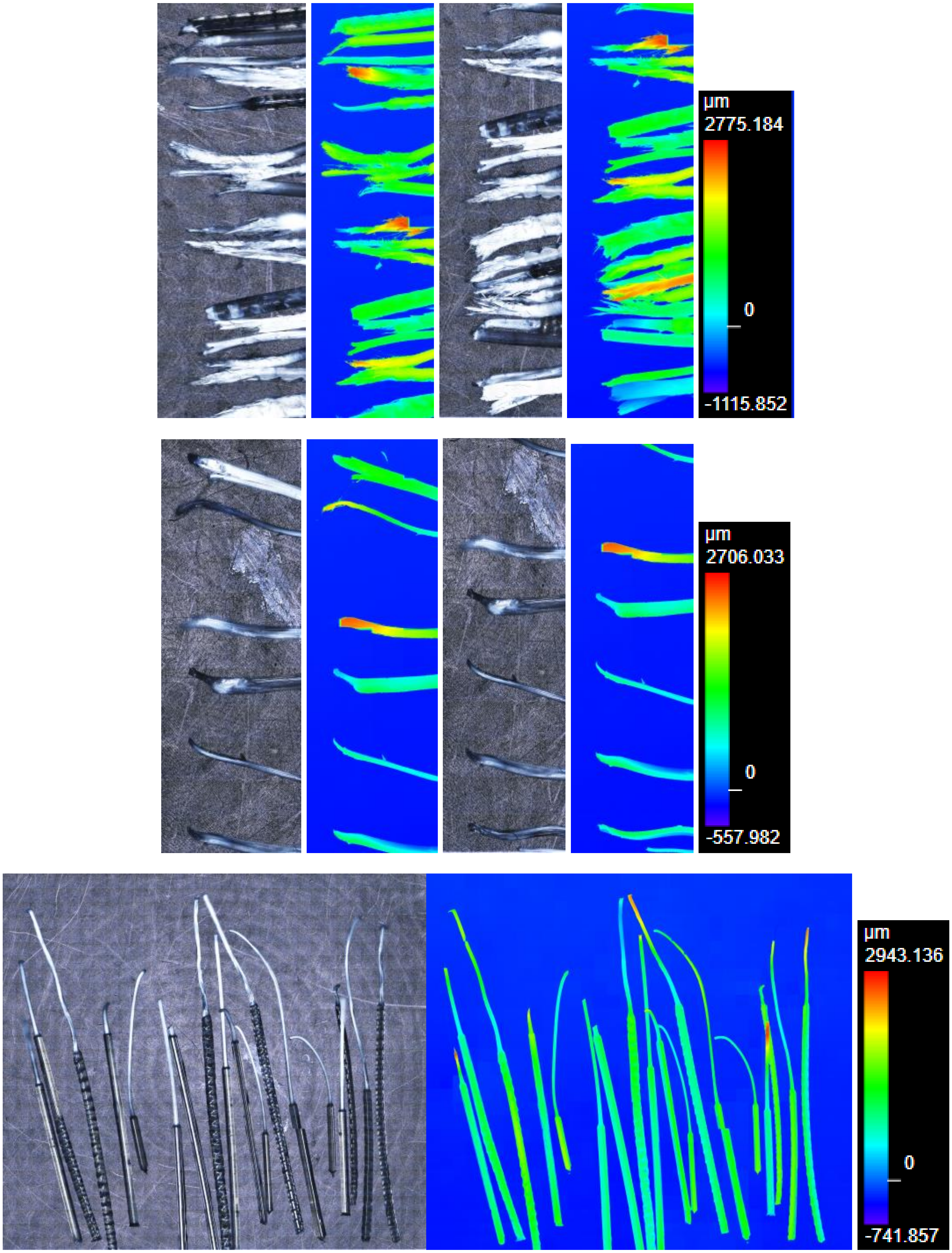


Figure S33. Laser microscope images (x5) of the neck formation in the filaments of 50 % PP + 50 % PLA during the tensile test.

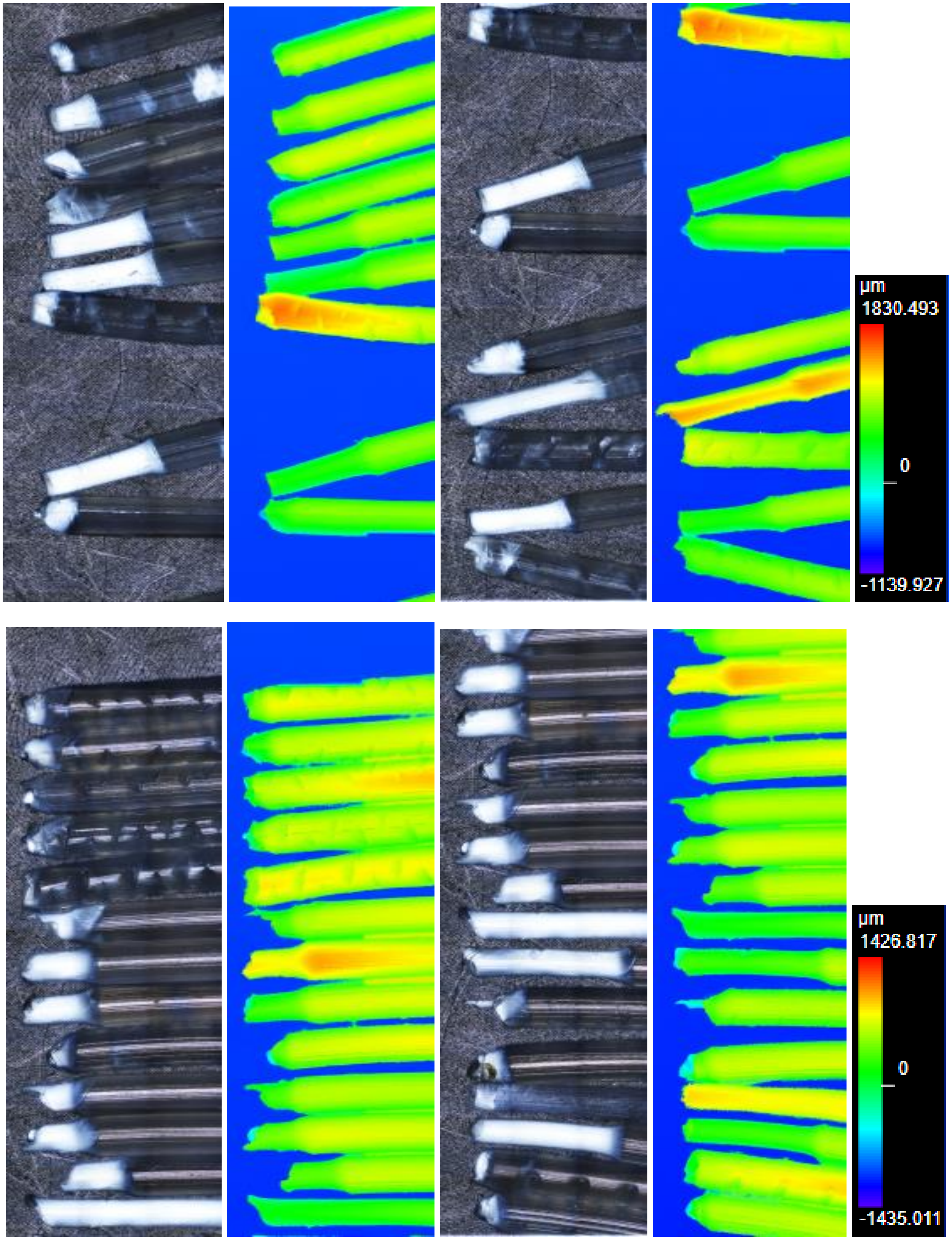


Figure S34. Laser microscope images (x5) of the failure of the filaments of 10 % PP 90 % PLA in the tensile test.

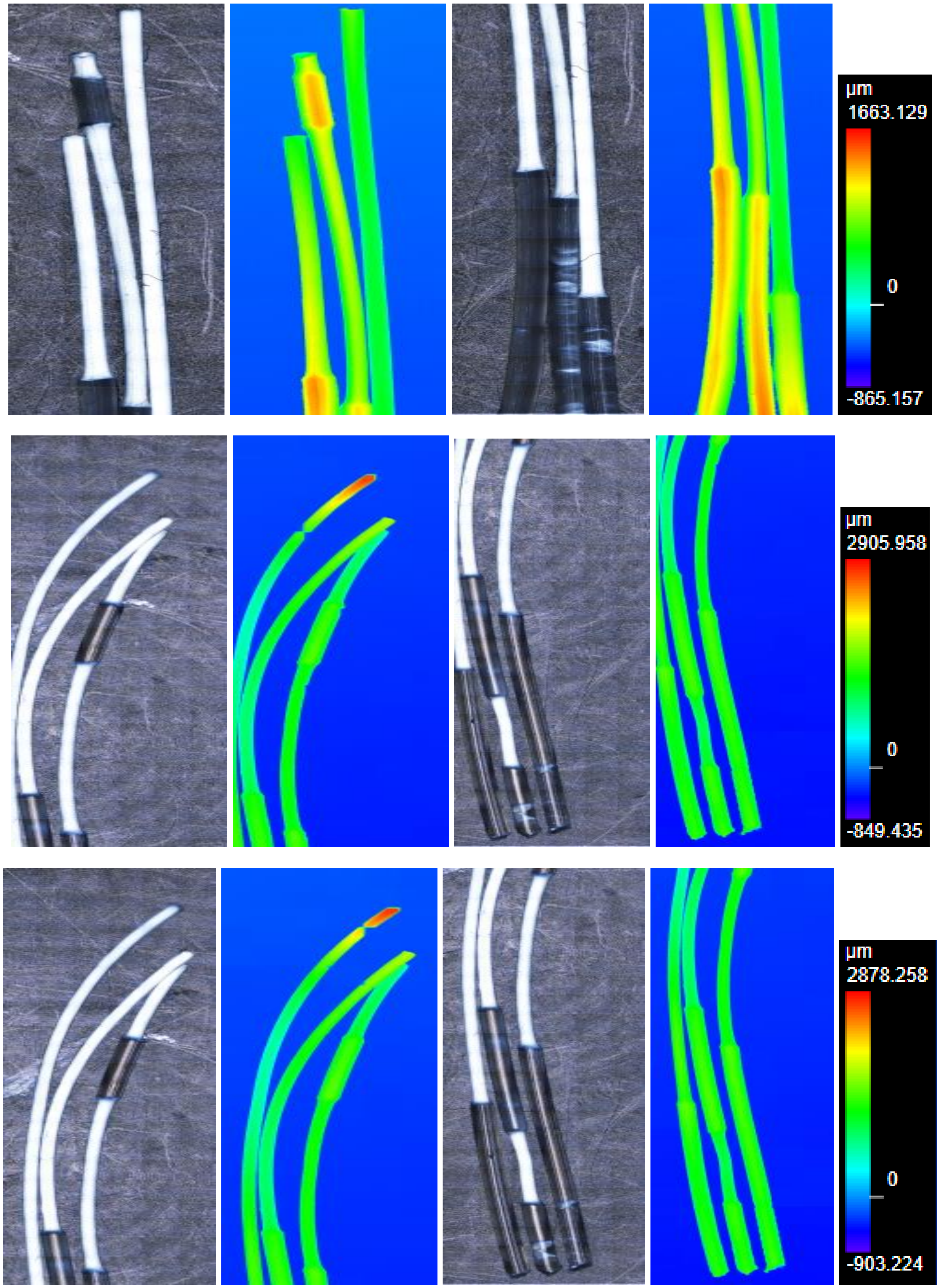


Figure S35. Laser microscope images (x5) of the neck formation in the filaments of 10 % PP 90 % PLA during the tensile test.

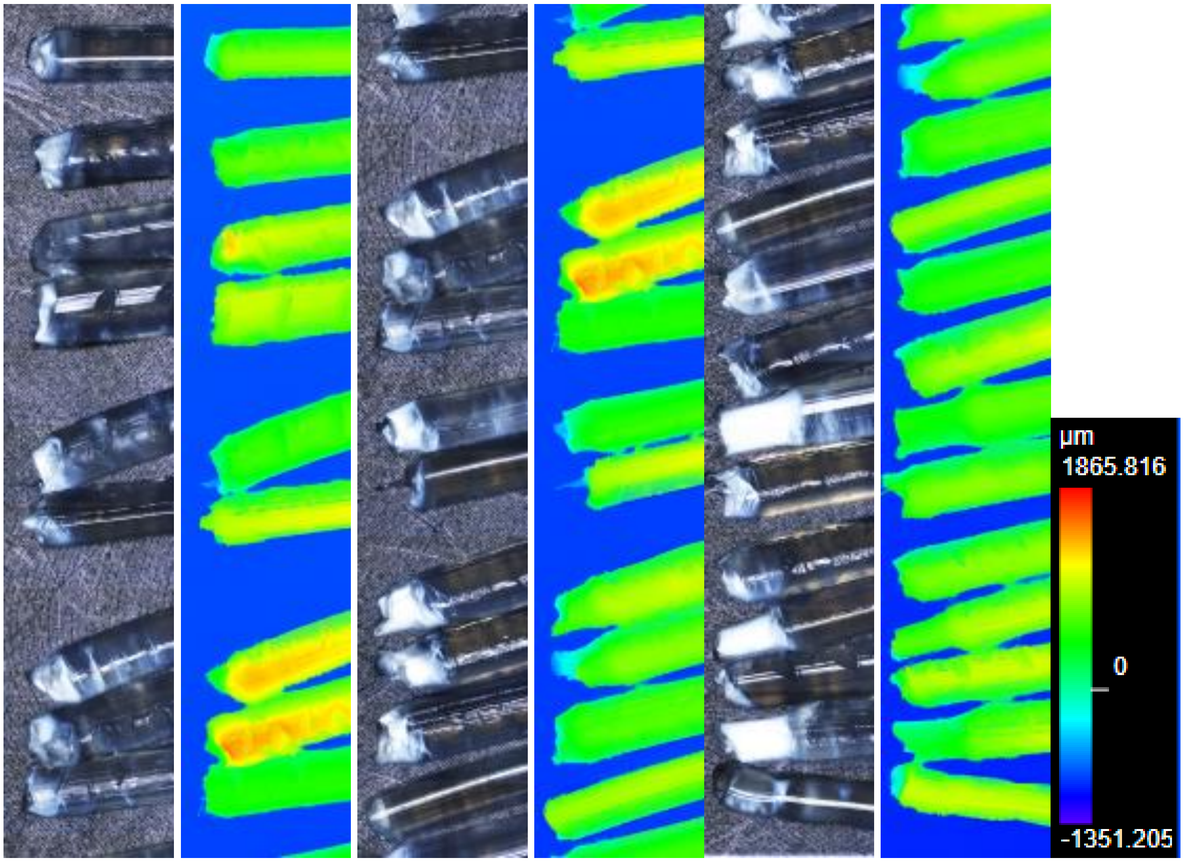


Figure S36. Laser microscope images (x5) of the rupture of the filaments of PLA.

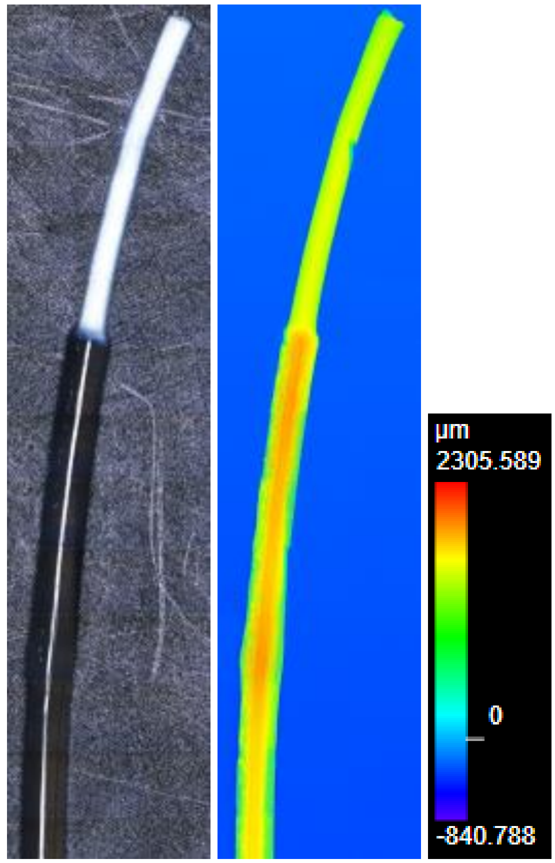


Figure S37. Laser microscope images (x5) of the failure of the filaments of PLA (with neck formation).

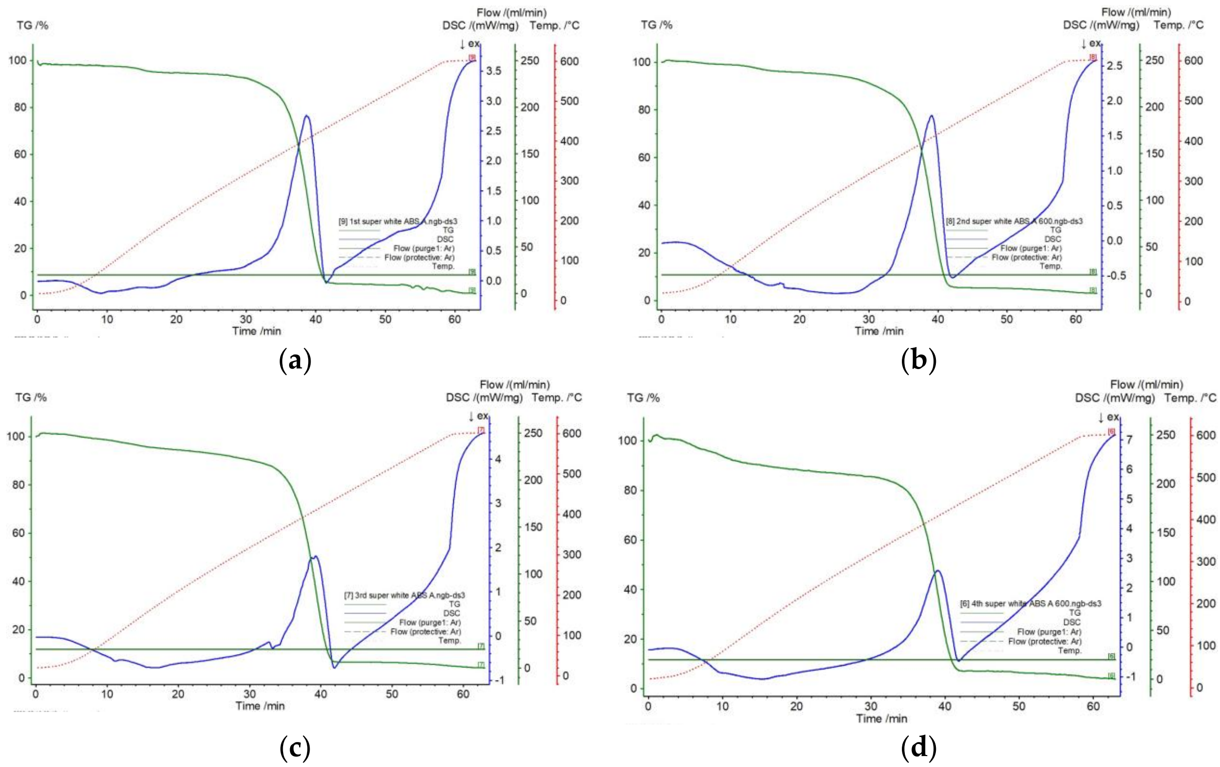


Figure S38. TGA/DSC profiles of the fraction of white ABS isolated with the acetone extraction: (**a**) 1st supernatant, (**b**) 2nd supernatant, (**c**) 3rd supernatant, and (**d**) 4th supernatant.

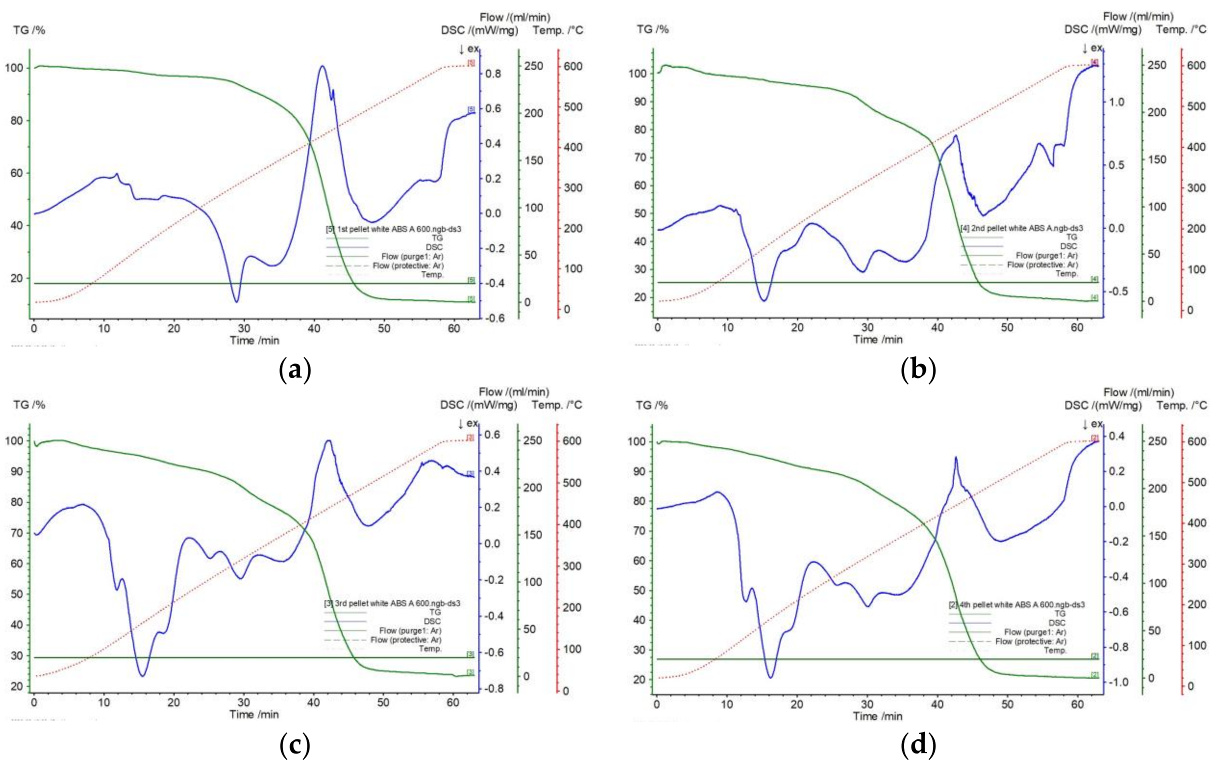


Figure S39. TGA/DSC profiles of the fraction of white ABS isolated with the acetone extraction: (**a**) 1st pellet, (**b**) 2nd pellet, (**c**) 3rd pellet, and (**d**) 4th pellet.

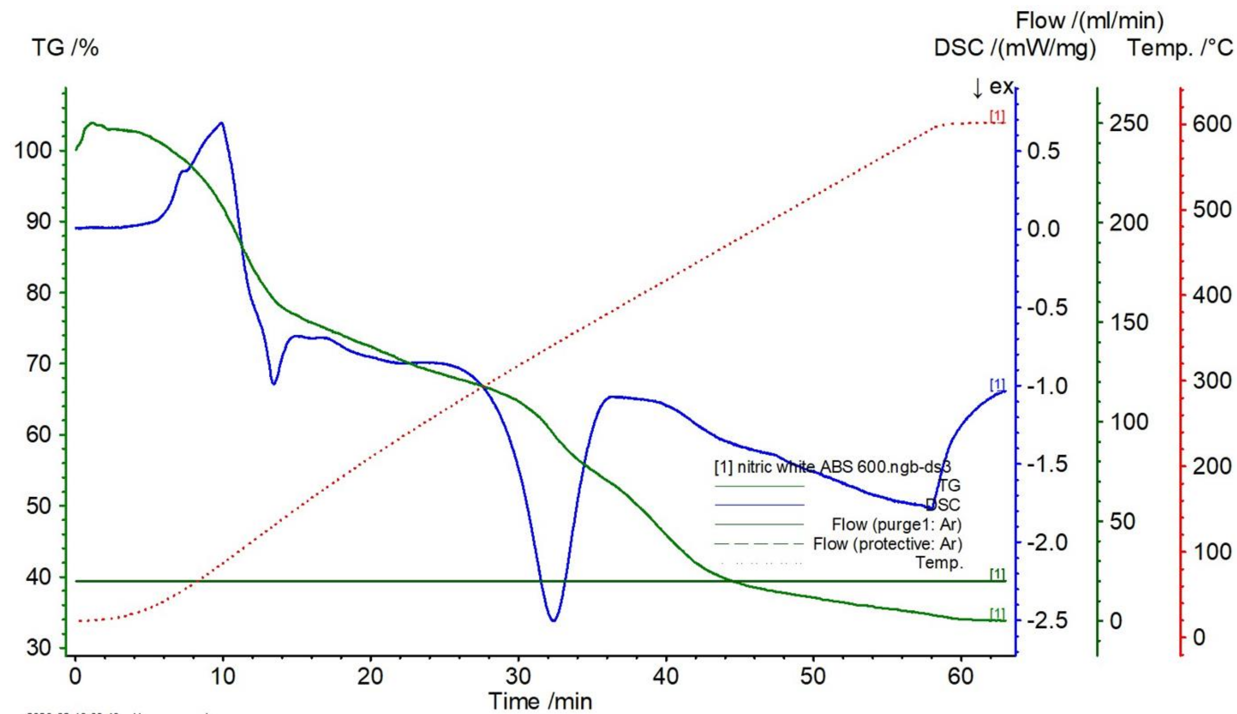
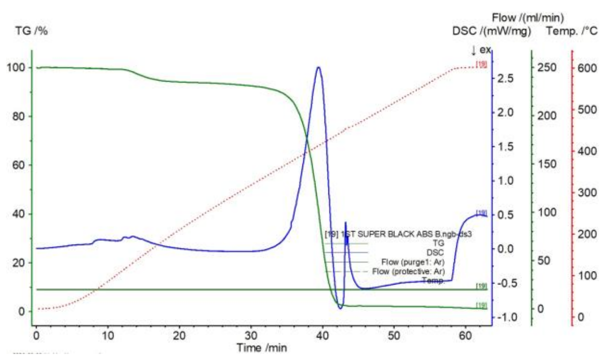
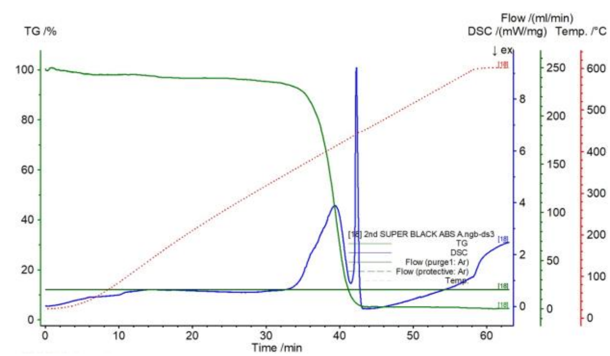


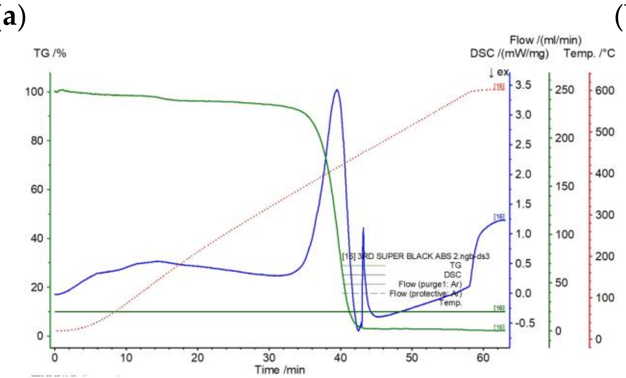
Figure S40. TGA/DSC profiles of the fraction of the white ABS soaked for 2 weeks in nitric acid (70 wt.%) with intermittent shaking.



(**a**)

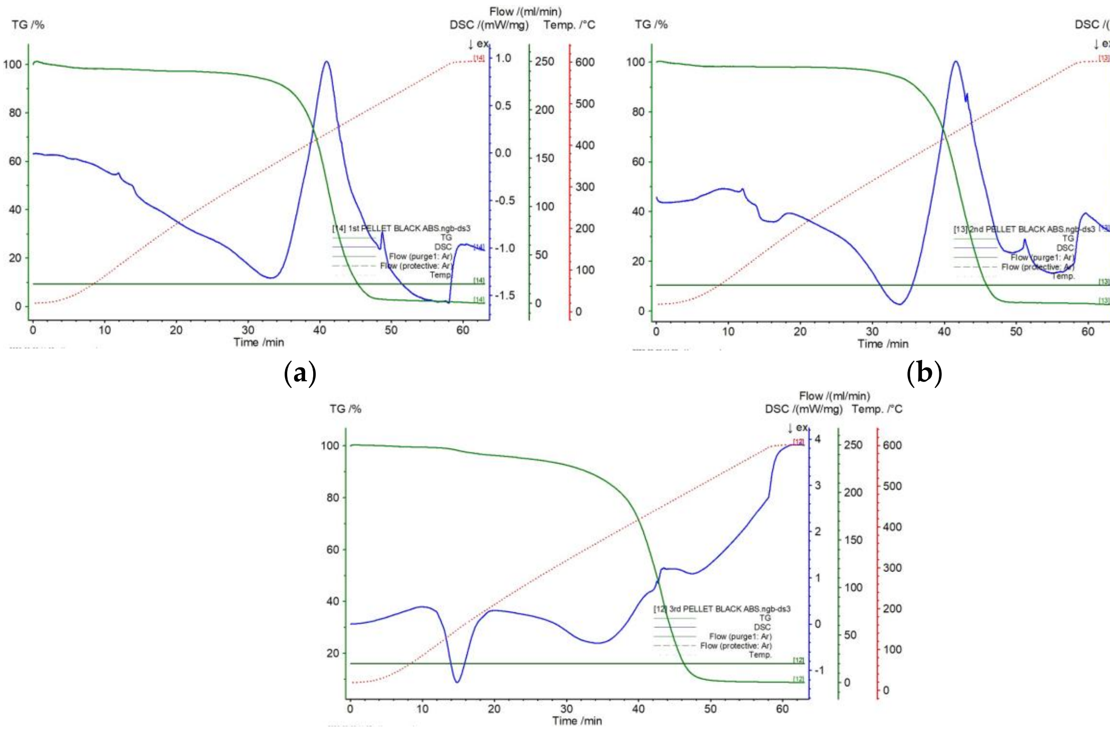


(**b**)



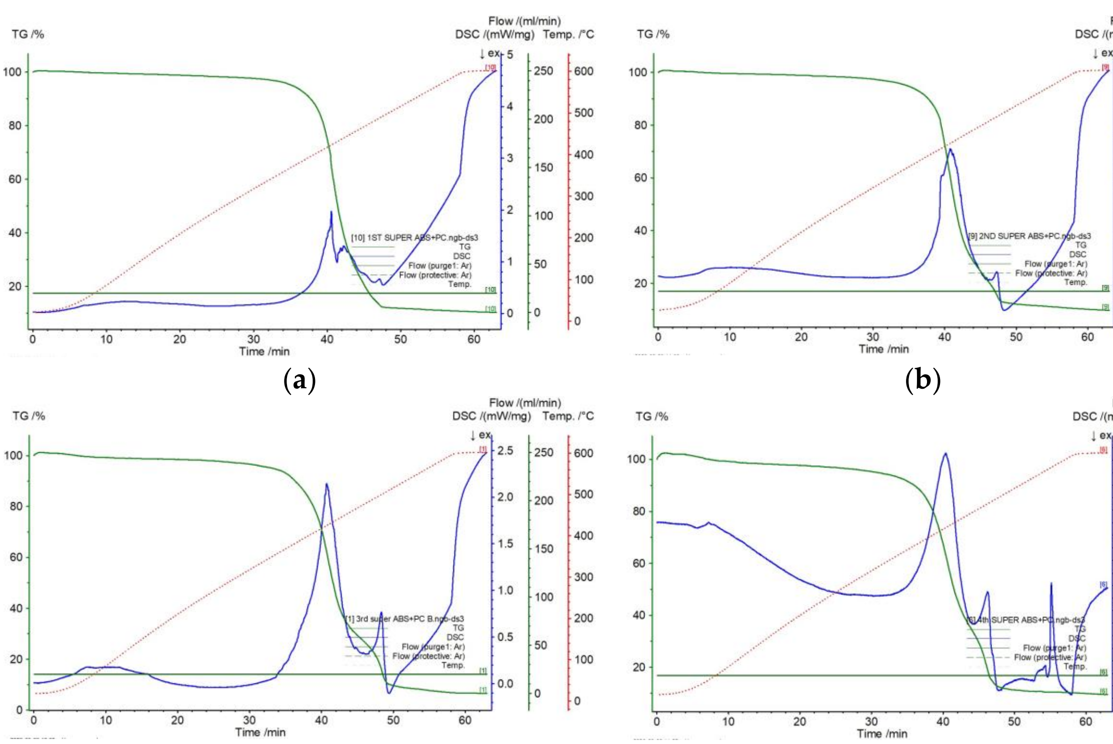
(**c**)

Figure S41. TGA/DSC profiles of the fraction of black ABS isolated with the acetone extraction: (**a**) 1st supernatant, (**b**) 2nd supernatant, and (**c**) 3rd supernatant.



(**a**) (**b**) (**c**)

Figure S42. TGA/DSC profiles of the fraction of black ABS isolated with the acetone extraction: (**a**) 1st pellet, (**b**) 2nd pellet, and (**c**) 3rd pellet.



(**a**) (**b**) (**c**) (**d**)

Figure S43. TGA/DSC profiles of the fraction of ABS+PC isolated with the acetone extraction: (**a**) 1st supernatant, (**b**) 2nd supernatant, (**c**) 3rd supernatant, and (**d**) 4th supernatant.

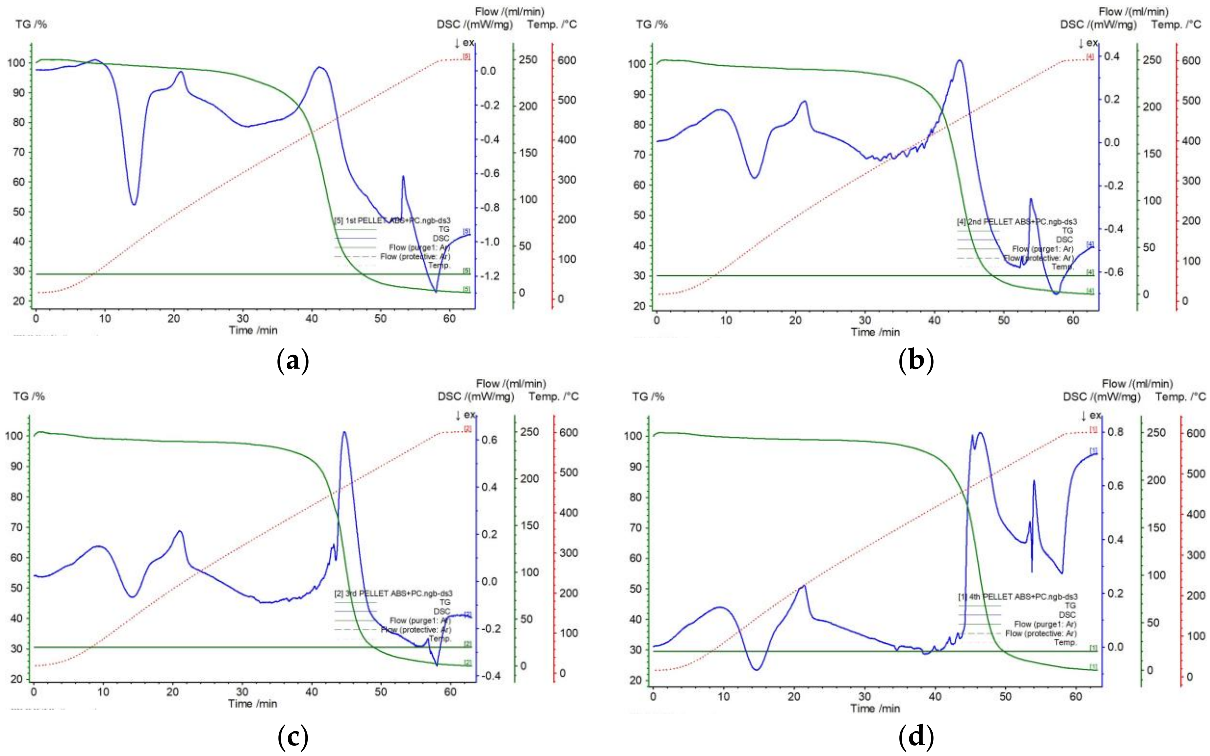


Figure S44. TGA/DSC profiles of the fraction of ABS+PC isolated with the acetone extraction: (**a**) 1st pellet, (**b**) 2nd pellet, (**c**) 3rd pellet, and (**d**) 4th pellet.

Table S1. Extraction of the white ABS with nitric acid (70 wt. %) conducted for 2 weeks with intermittent shaking.

	$C_{15}H_{17}N$	Ti/(mg/kg)	Fe/(mg/kg)	Cu/(mg/kg)	Sb/(mg/kg)	Br/(mg/kg)
Before	99.149	4728	165	4.7	671.2	2939.3
After	99.886	786.5	12.3	1.0	35.4	305.0

Table S2. Extraction of the black ABS with nitric acid (70 wt. %) conducted for 2 weeks with intermittent shaking.

	S/(mg/kg)	Ca/(mg/kg)	Zn/(mg/kg)	Nd/(mg/kg)	Fe/(mg/kg)
Before	300.3	432.8	4.7	51.7	15.4
After	99.6	225.7	2.2	4.4	7.7
	$C_{15}H_{17}N$/(%)	Ti/(mg/kg)	Cu/(mg/kg)	Br/(mg/kg)	Ni/(mg/kg)
Before	99.8	224.4	1.4	9.0	6.0
After	99.951	142.2	1.0	7.7	1.5

(**a**) (**b**)

Figure S45. (**a**) Material that was found among the plastic e-waste. (**b**) Metal parts that remained inside the melt-blend extruder and they needed to be purged with Devoclean MidTemp (polyethylene).

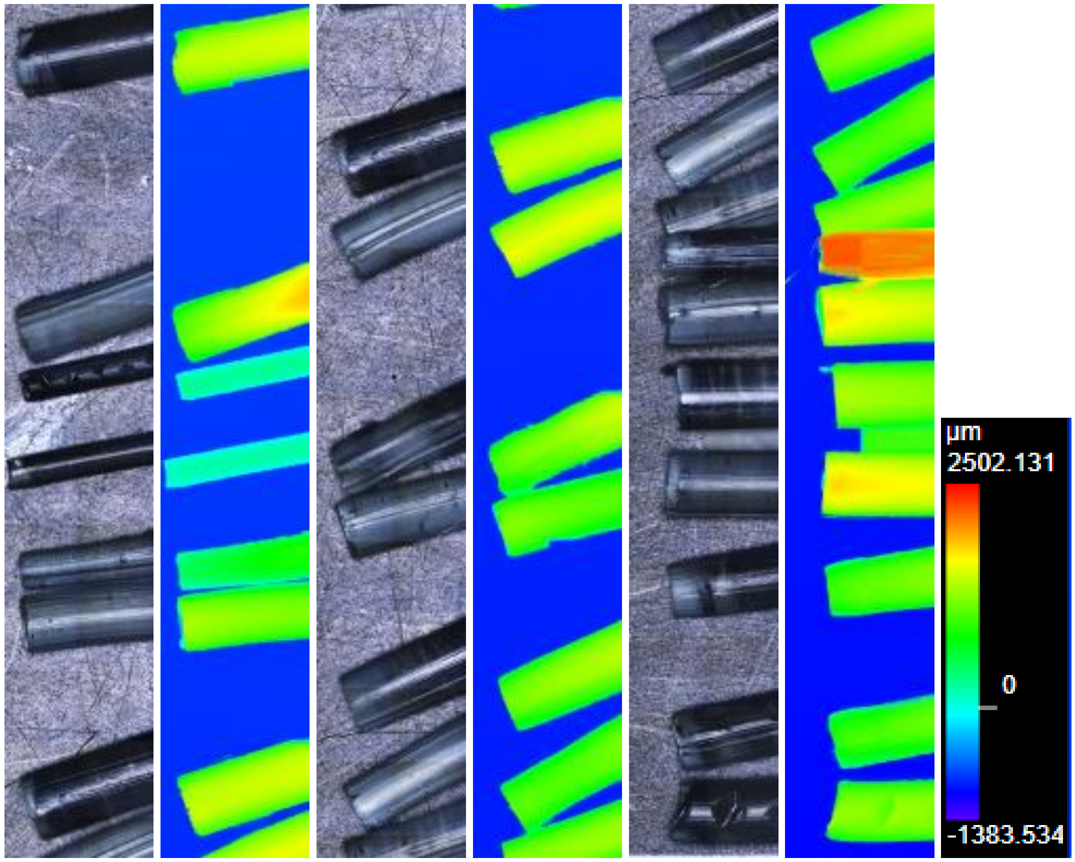


Figure S46. Laser microscope images (x5) of the rupture of the filaments of clogging ABS 100 % in the tensile test.

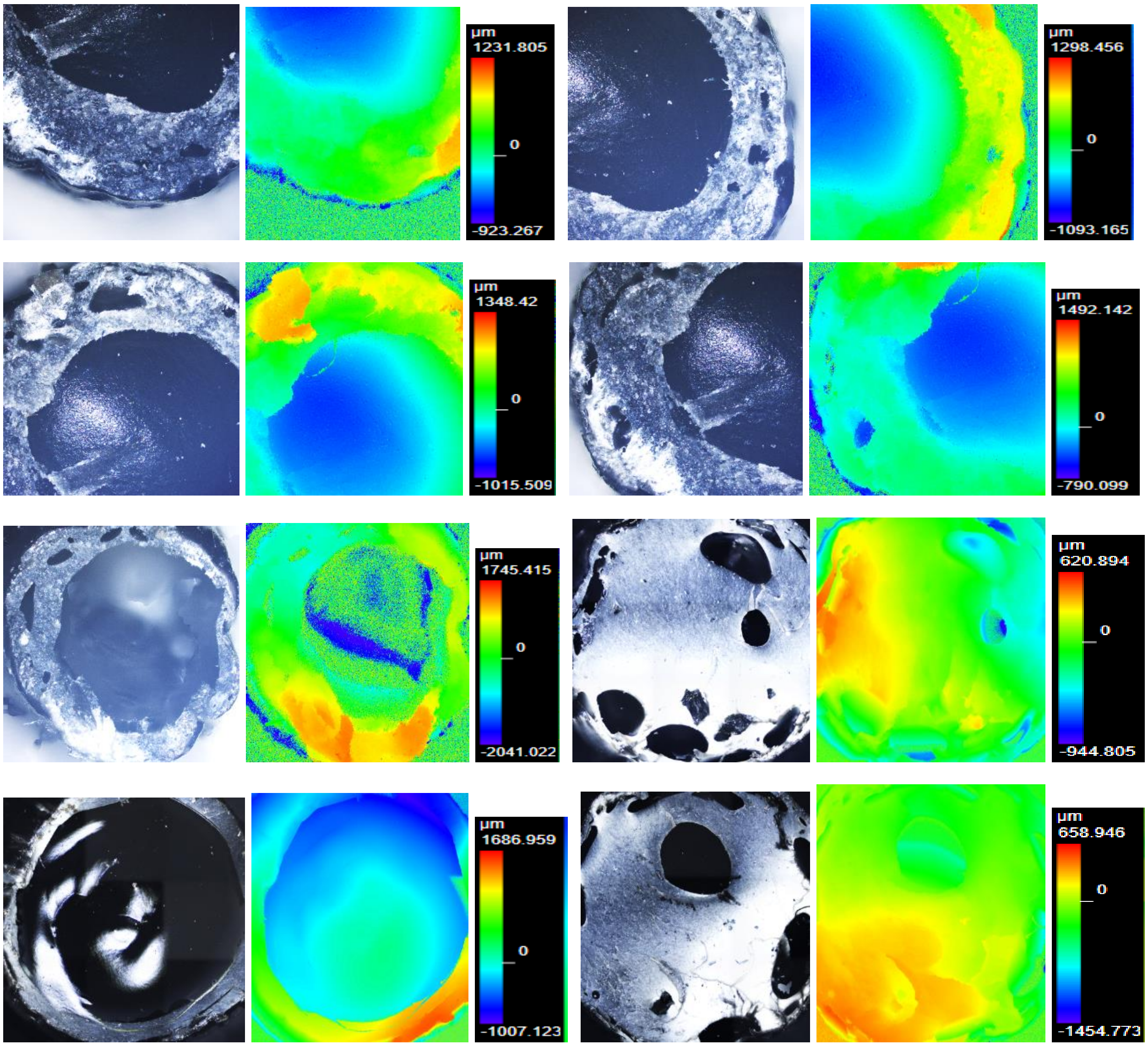
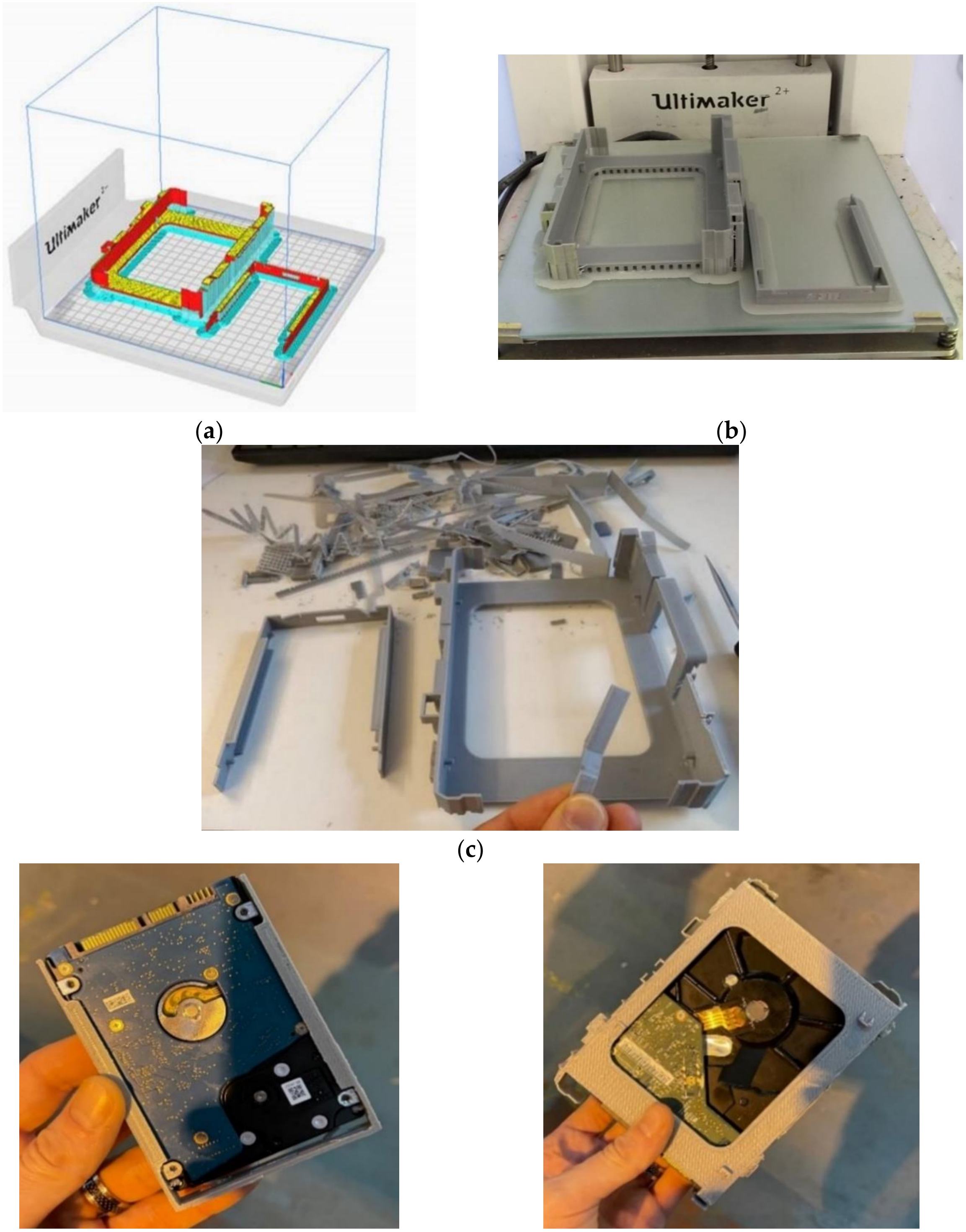


Figure S47. Laser microscope images (x10) of the failure of the filaments of Clogging ABS 100 % in the tensile test.



(**a**) (**b**)

(**c**)

(**d**) (**e**)

Figure S48. (**a**) UltiMaker Cura visualization of the supportive material (blue color) that will be required to print the hard drive caddies with ABS. (**b**) Printed hard drive caddies with ABS. (**c**) Removal of the supportive material (30 % of the total ABS) from the hard drive caddies printed with ABS. (**d**) Proof that the small hard drive caddy fits for purpose. (**e**) Proof that the big hard drive caddy fits for purpose.