Supplementary

Table S1. The percentages of C, O and Ti from various species.

Binding energy, eV	**Chemical bonding**	**Concentration, %**		
		PHB/Ti-FA 5 NH_3-150°C	PHB/Ti-FA 10	PHB/Ti-FA 5 NH_3-RT
285.0	C-C	54.9	54.7	53.6
286.5	C-O/C=N	24.3	27.6	25.0
288.9	C=O	20.8	17.8	21.4
530.0	O-Ti	6.1	1.0	2.3
531.3	C=O	20.4	11.6	19.7
532.2	OH^-	35.4	43.3	40.1
533.3	C-O	31.1	35.3	33.5
534.2	H_2O	7.0	8.8	4.4
$Ti2p_{3/2}/Ti2p_{1/2}$ Δ=5.7	oxidation state			
457.5/463.2	Ti^{3+}	33.5	-	30.0
458.7/464.4	Ti^{4+}	66.5	-	70.0

Table S2. The percentages of Ti from various species.

Binding energy, eV	**Chemical bonding**	**Concentration, %**		
		Ti-FA NH_3-150°C	Ti-FA NH_3-RT	Ti -FA
$Ti2p_{3/2}/Ti2p_{1/2}$ Δ=5.7	oxidation state			
459.5/465.2	Ti^{3+}	5.8	6.6	8.1
458.5/464.2	Ti^{4+}	94.2	93.4	91.9

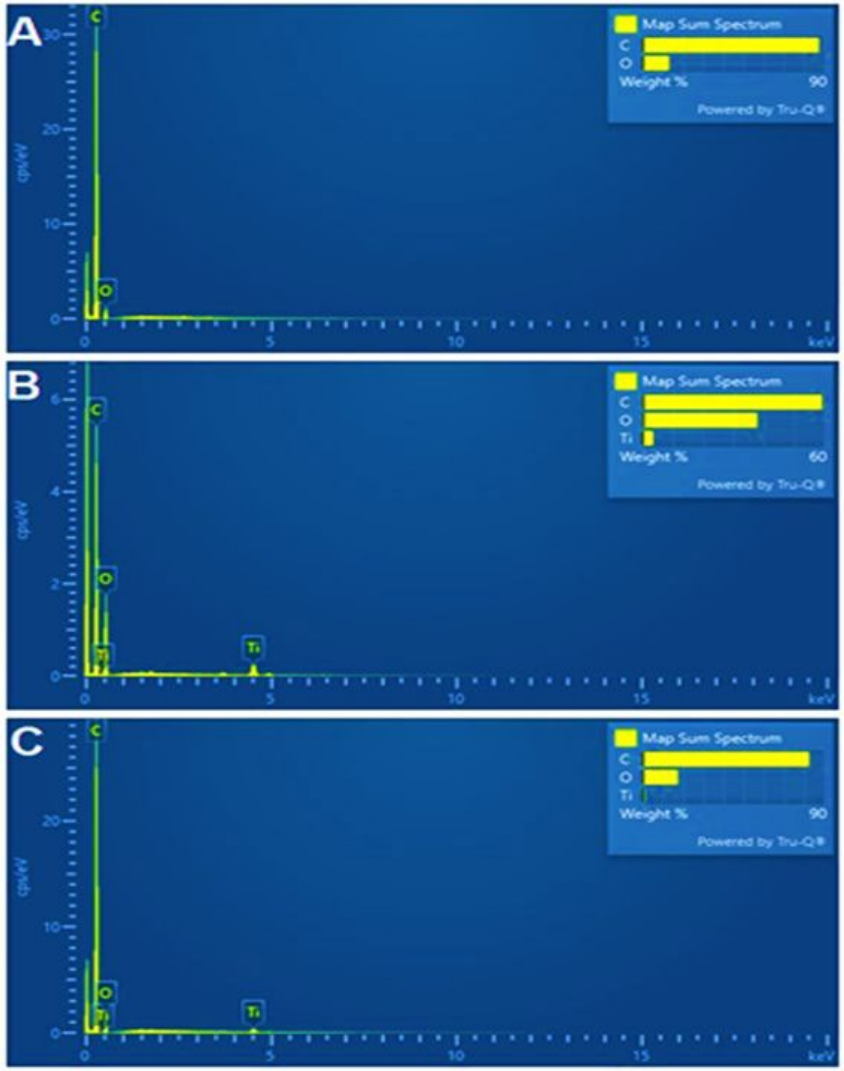


Figure S1. EDS spectra of (A) pure PHB and (B) PHB/TiFA 5 NH_3; (C) PHB/TiFA 10 NH_3 polyhydroxybutyrate electrospun fibrous membranes loaded with TiFA nanophase.

TGA/GC/MSD analysis of isolated Ti-FA nanopowder:



TGA/GC/MSD system equipment at IP-BAS:

PerkinElmer TGA4000, RedShift valve controller, 2 high temperature gas valves, heated transfer line, GC PE Clarus 680S, MSD PE Clarus SQ8S.

S/Sl capillary inlet,

1m x 0.25mm uncoated fused silica capillary from inlet to GV2,

Capillary column PE-5ms 30m x 0.25mm x 0.25µm from GV2 to GV1

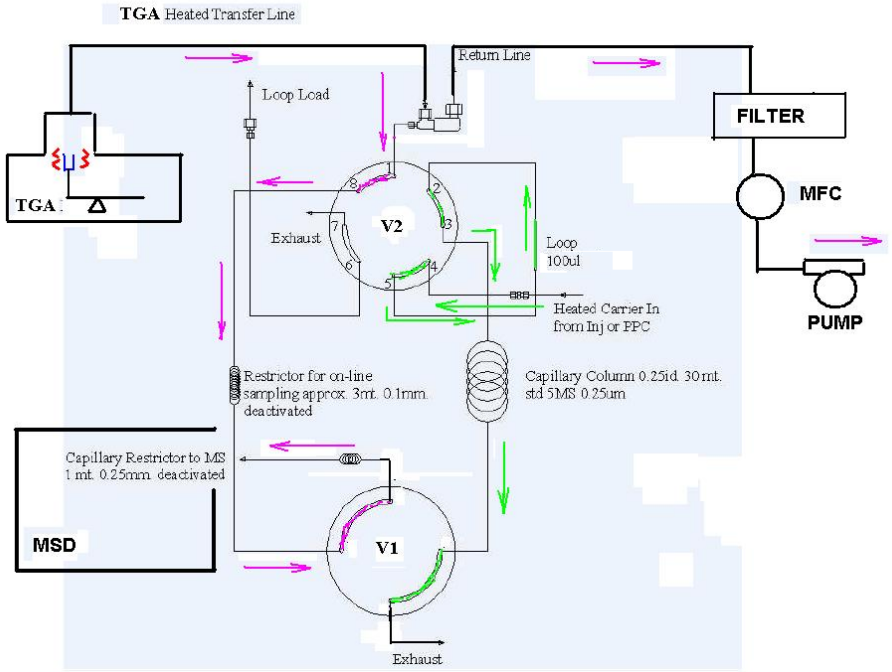
1m x 0.25mm uncoated fused silica capillary from GV1 to MSD transfer line.

3m x 0.10mm uncoated fused silica capillary from GV1 to GV2.

Instrument Control, Data Acquisition and Data Processing were performed by

GC/MSD software TurboMass v.6.1.0.1963.

Pneumatic flow diagram (Conditions2):



Conditions 1 TGA/GC/MSD:

Argon flow on TGA4000 - 65ml/min.

Argon flow from TGA4000 to membrane pump - 35ml/min.

TGA Temperature Program:

- 40°C to 800°C – step 15°C/min.
- 800°C – hold 3min.
- Start signal to GC – manual at 270°C.

Transfer line temperature - 140°C;

GV1 and GV2 temperature - 140°C;

- Mobile Phase – Helium 5.0.
  - Mobile Phase Mode - Constant Flow.
  - Calculated Flow - 1.0 ml/min.
  - GC Injector Temperature – 160°C.
- Transfer Line Temperature – 180°C.
- GC Oven Program
  - 40°C – hold 1min.
  - Heat rate 4°C/min to 80 °C – hold 0min.
  - Heat rate 10°C/min to 150 °C – hold 3min.

- MSD Transfer Line Temperature – 180^{o}C.

- MSD Ion Source Temperature – 220^{o}C.

- GV2 - On from 0.5 to 4 min.

- MSD mode – SCAN from m/z 35 to 400.

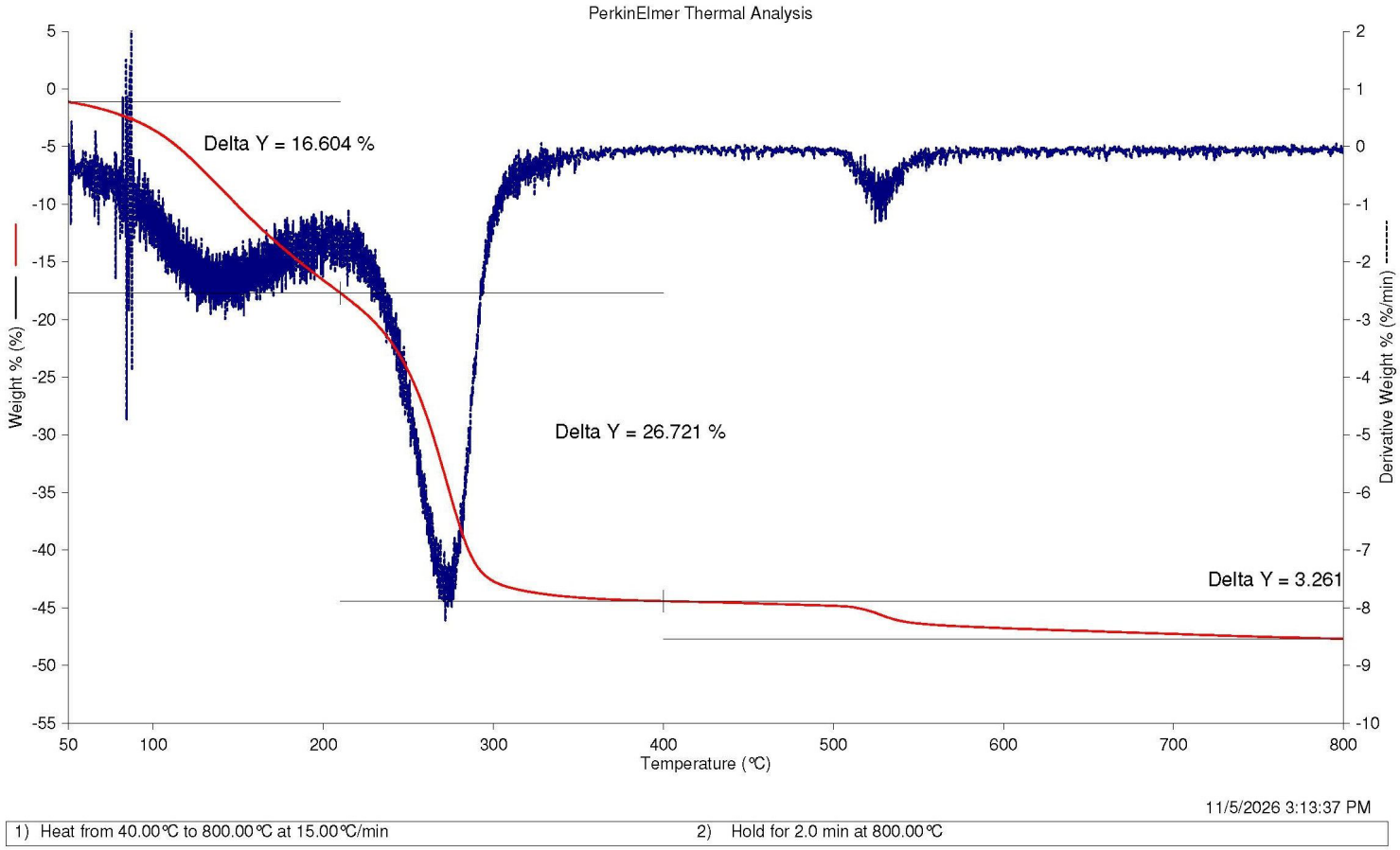
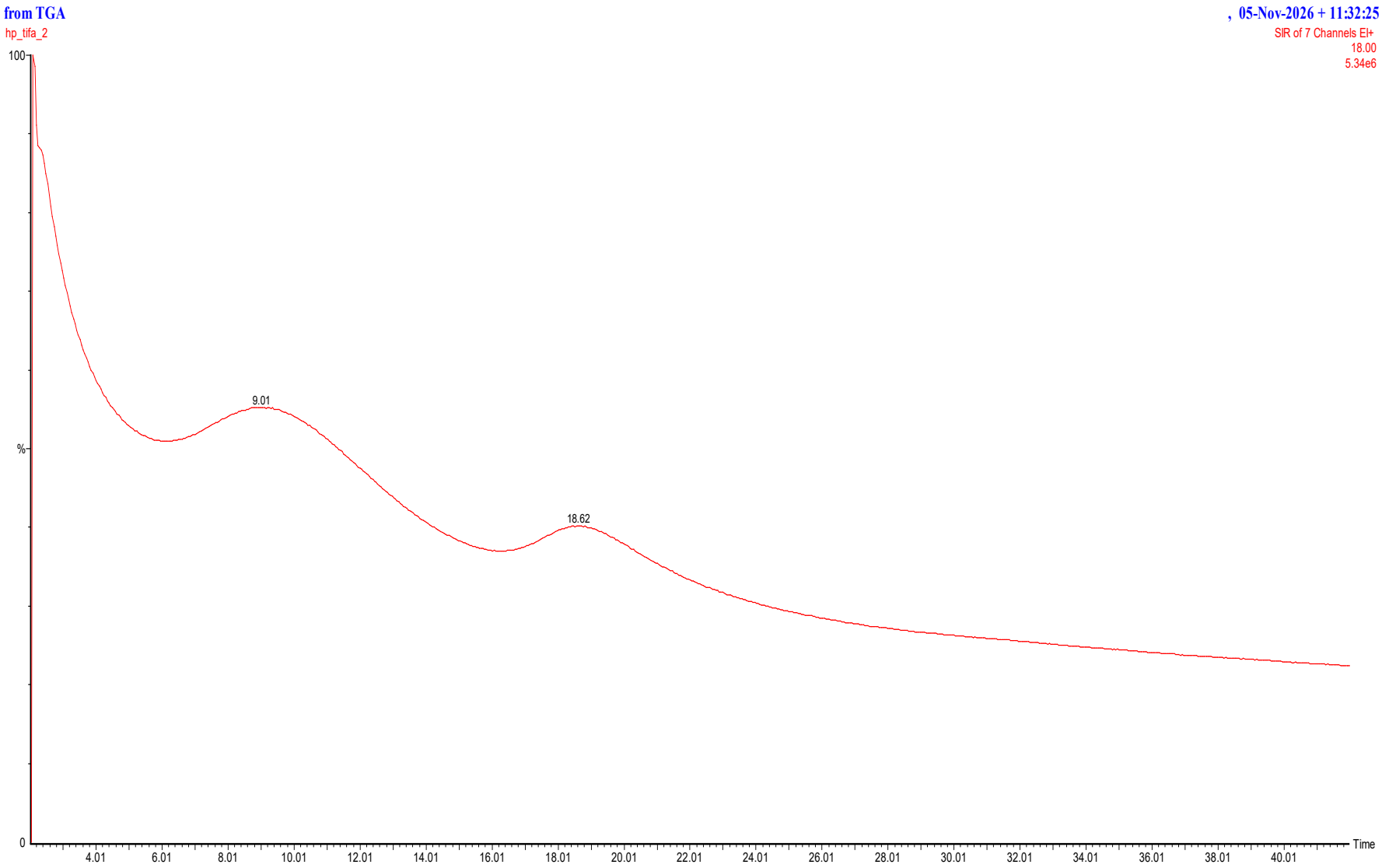
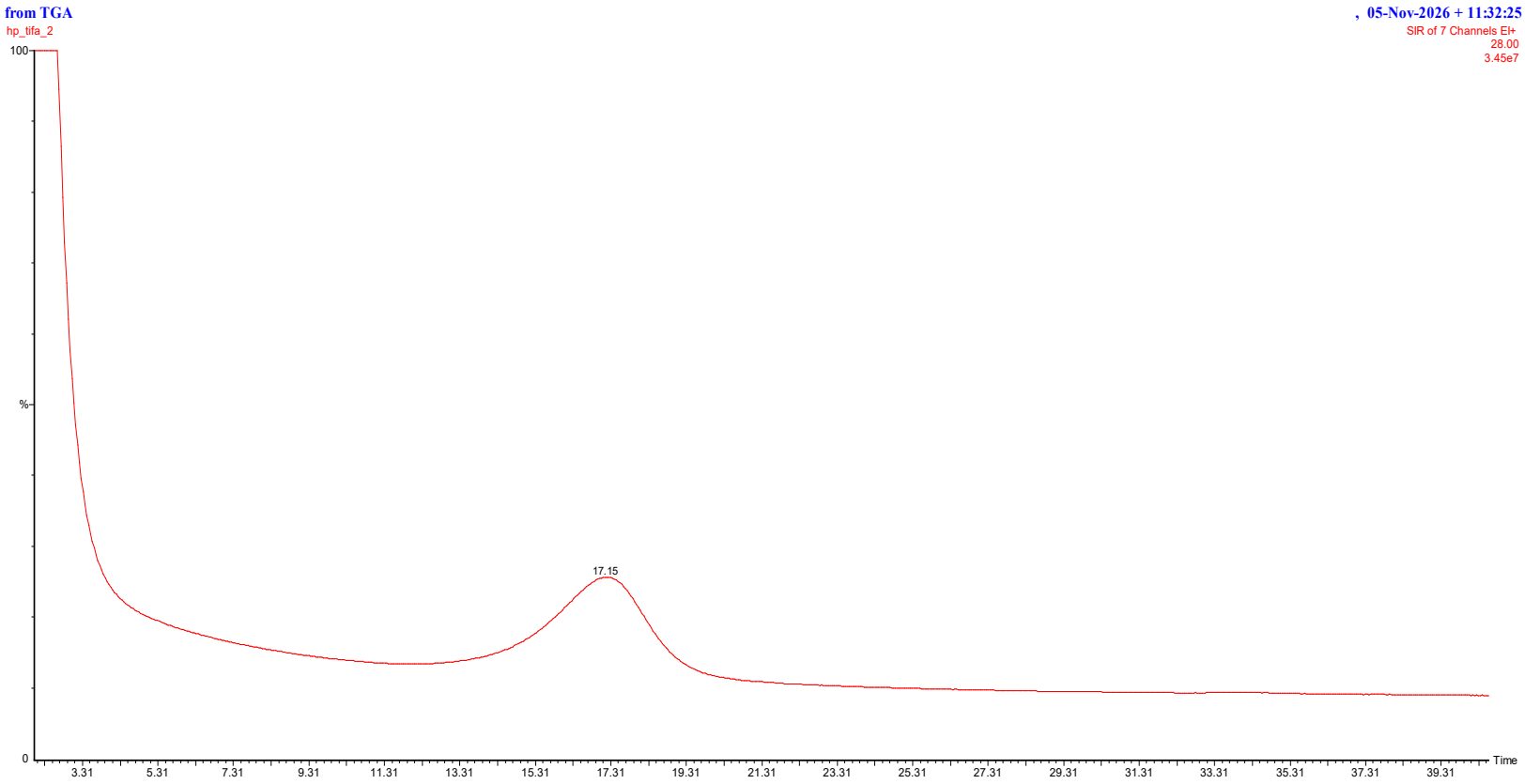


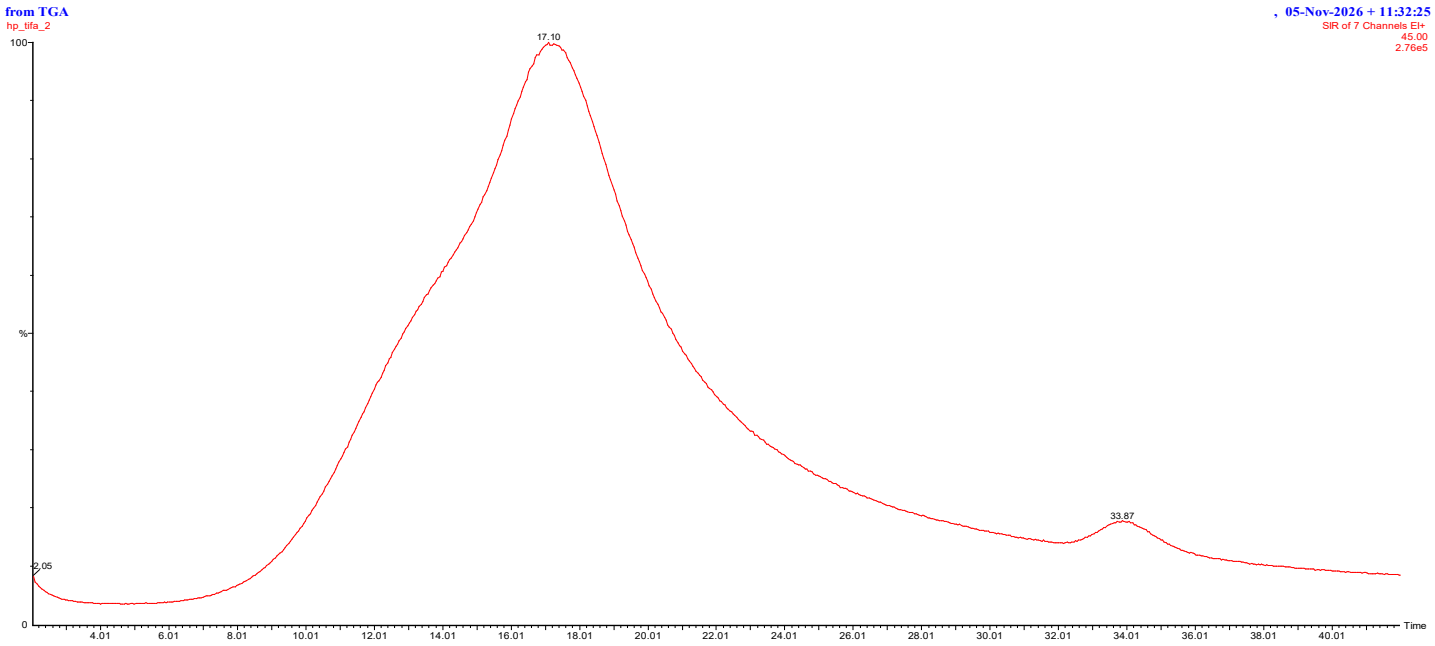
Figure S2. TG curve of the isolated TiFA nanopowder exhibiting the multi-step mass loss during continuous heating in an argon atmosphere up to 800 °C at a rate of 15 °C/min.


from TGA
hp_tifa_2
, 05-Nov-2026 + 11:32:25
SIR of 7 Channels EI+
18.00
5.34e6
100
%
0
9.01
18.62
4.01
6.01
8.01
10.01
12.01
14.01
16.01
18.01
20.01
22.01
24.01
26.01
28.01
30.01
32.01
34.01
36.01
38.01
40.01
Time

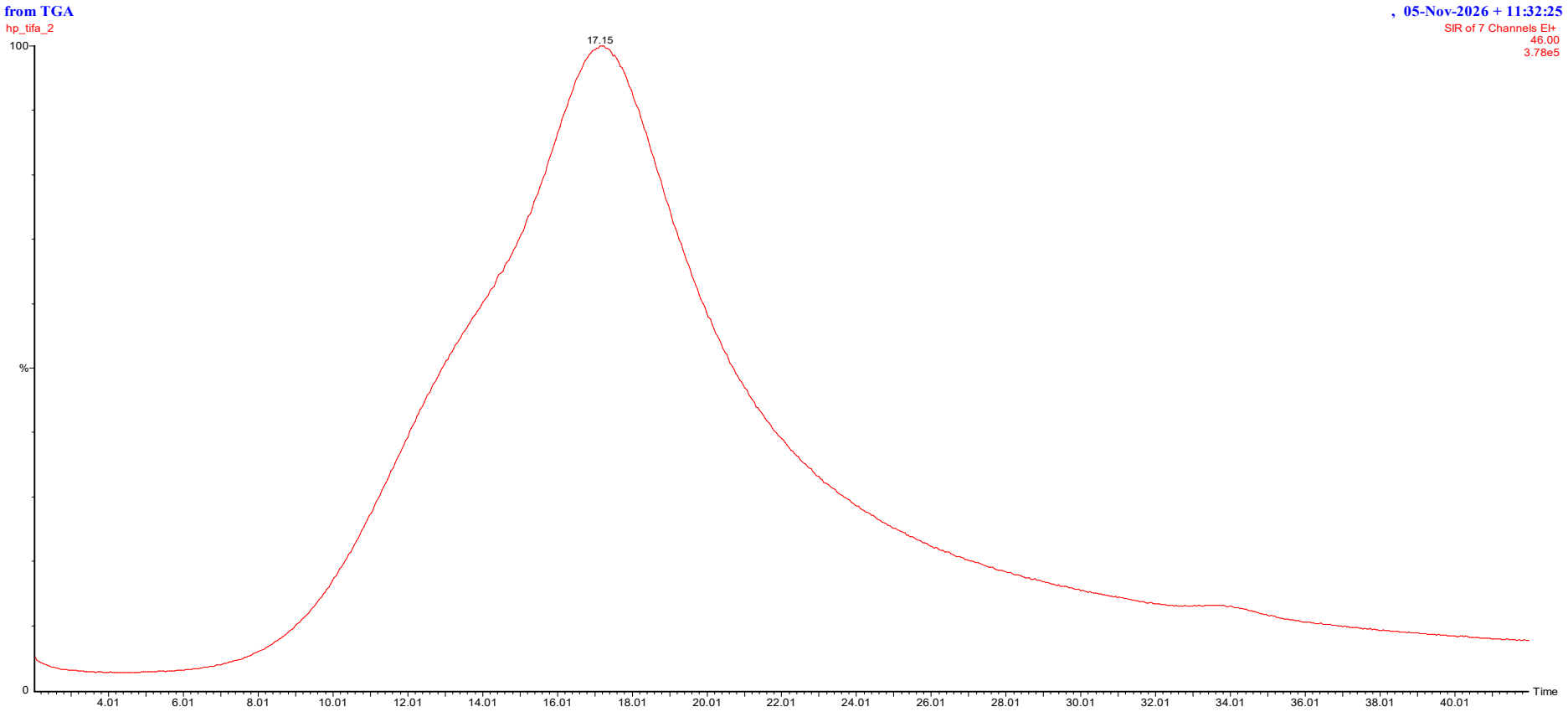
H_20


from TGA
hp_tifa_2
, 05-Nov-2026 + 11:32:25
SIR of 7 Channels EI+
28.00
3.45e7
100
%
0
17.15
3.31
5.31
7.31
9.31
11.31
13.31
15.31
17.31
19.31
21.31
23.31
25.31
27.31
29.31
31.31
33.31
35.31
37.31
39.31
Time

$CO + N_2$


from TGA
hp_tlfa_2
, 05-Nov-2026 + 11:32:25
SIR of 7 Channels EI+
45.00
2.76e5
100
%
0
17.10
33.87
2.05
4.01
6.01
8.01
10.01
12.01
14.01
16.01
18.01
20.01
22.01
24.01
26.01
28.01
30.01
32.01
34.01
36.01
38.01
40.01
Time

HCOOH


from TGA
hp_tifa_2
, 05-Nov-2026 + 11:32:25
SIR of 7 Channels EI+
46.00
3.78e5
17.15
100
%
0
4.01
6.01
8.01
10.01
12.01
14.01
16.01
18.01
20.01
22.01
24.01
26.01
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30.01
32.01
34.01
36.01
38.01
40.01
Time

HCOOH

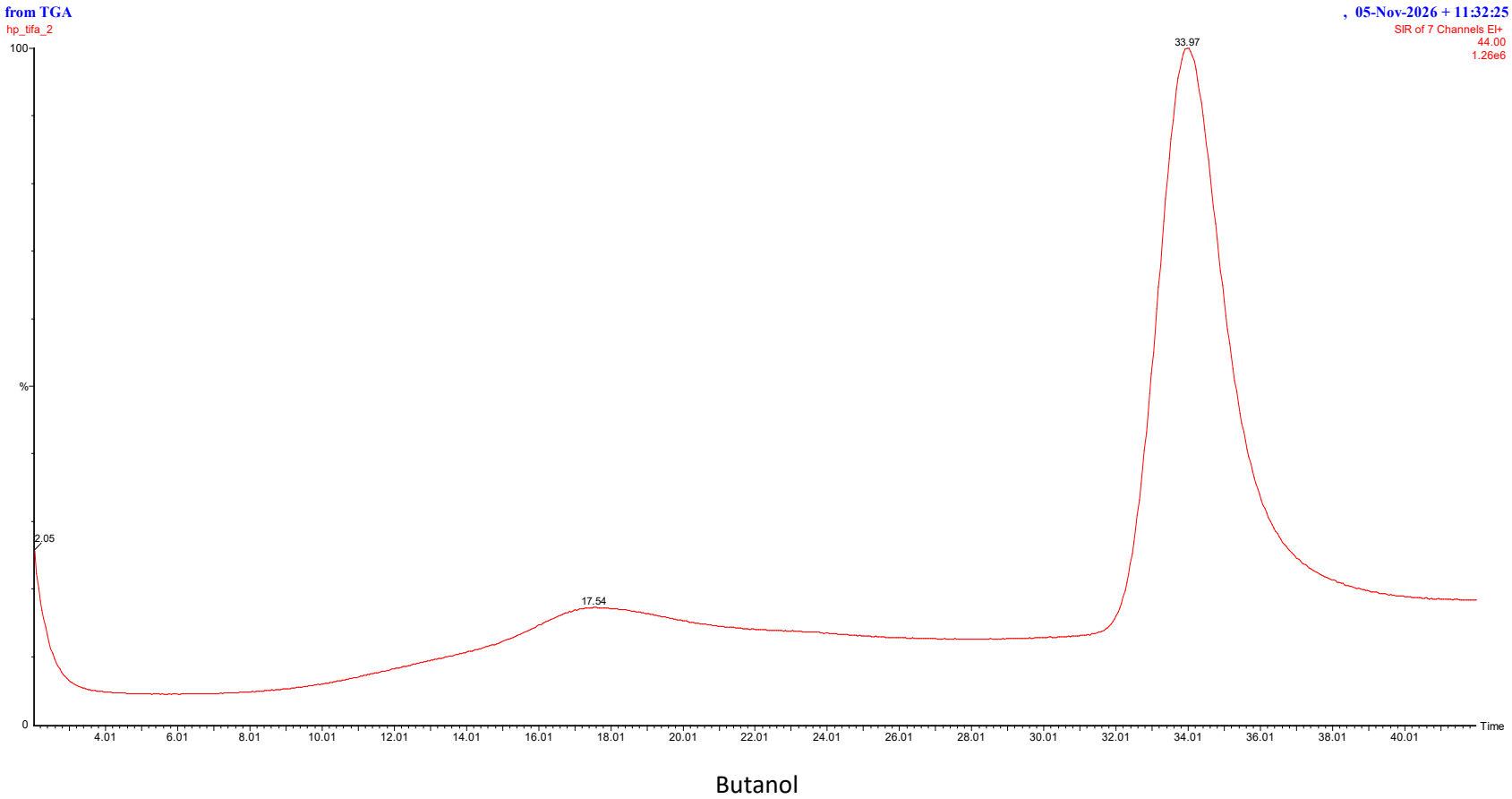


Figure S3. TGA/GC/MSD analysis of isolated TiFA nanopowder showing the identified thermal degradation products in the range 120–550 °C.