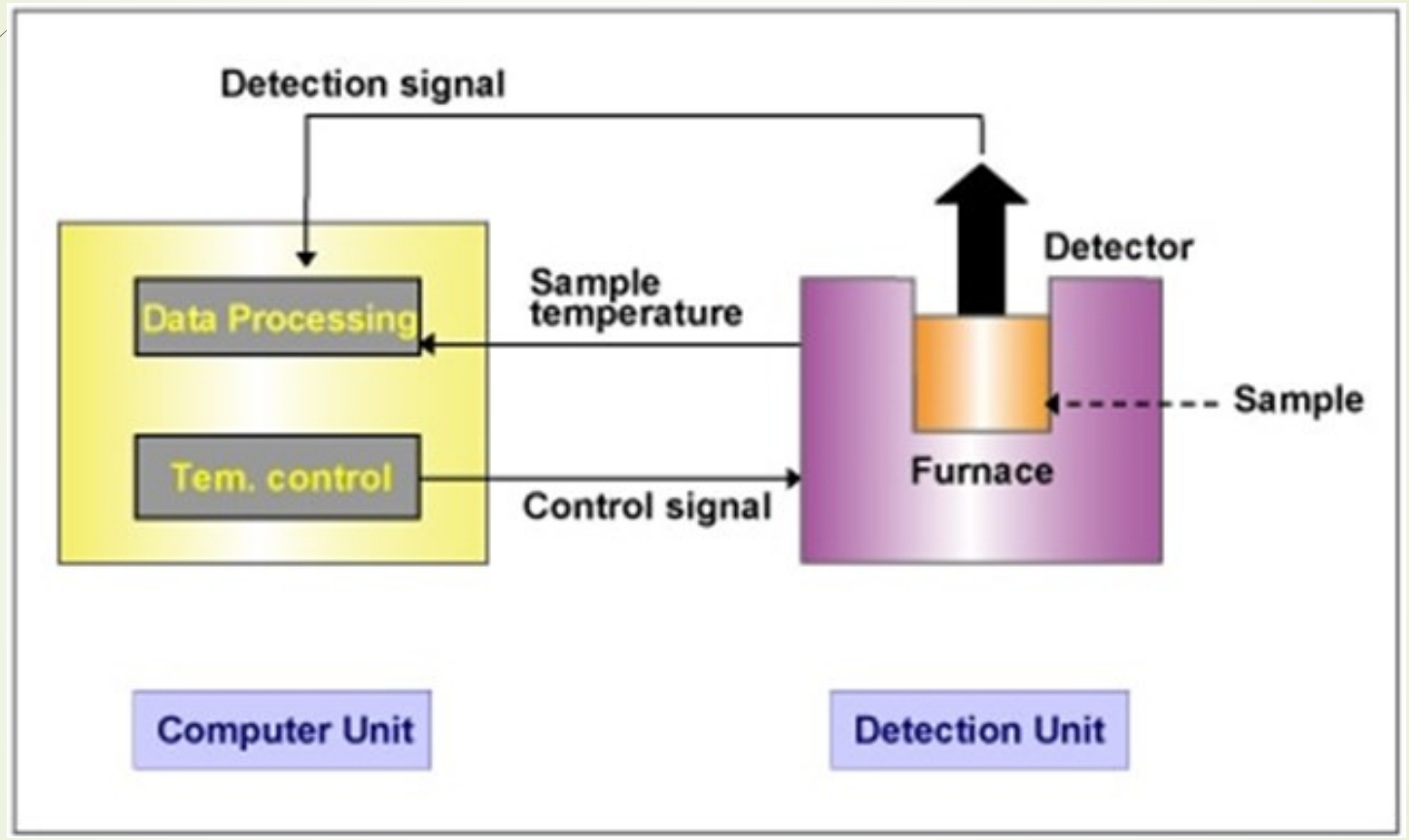
روش های نوین آنالیز مواد

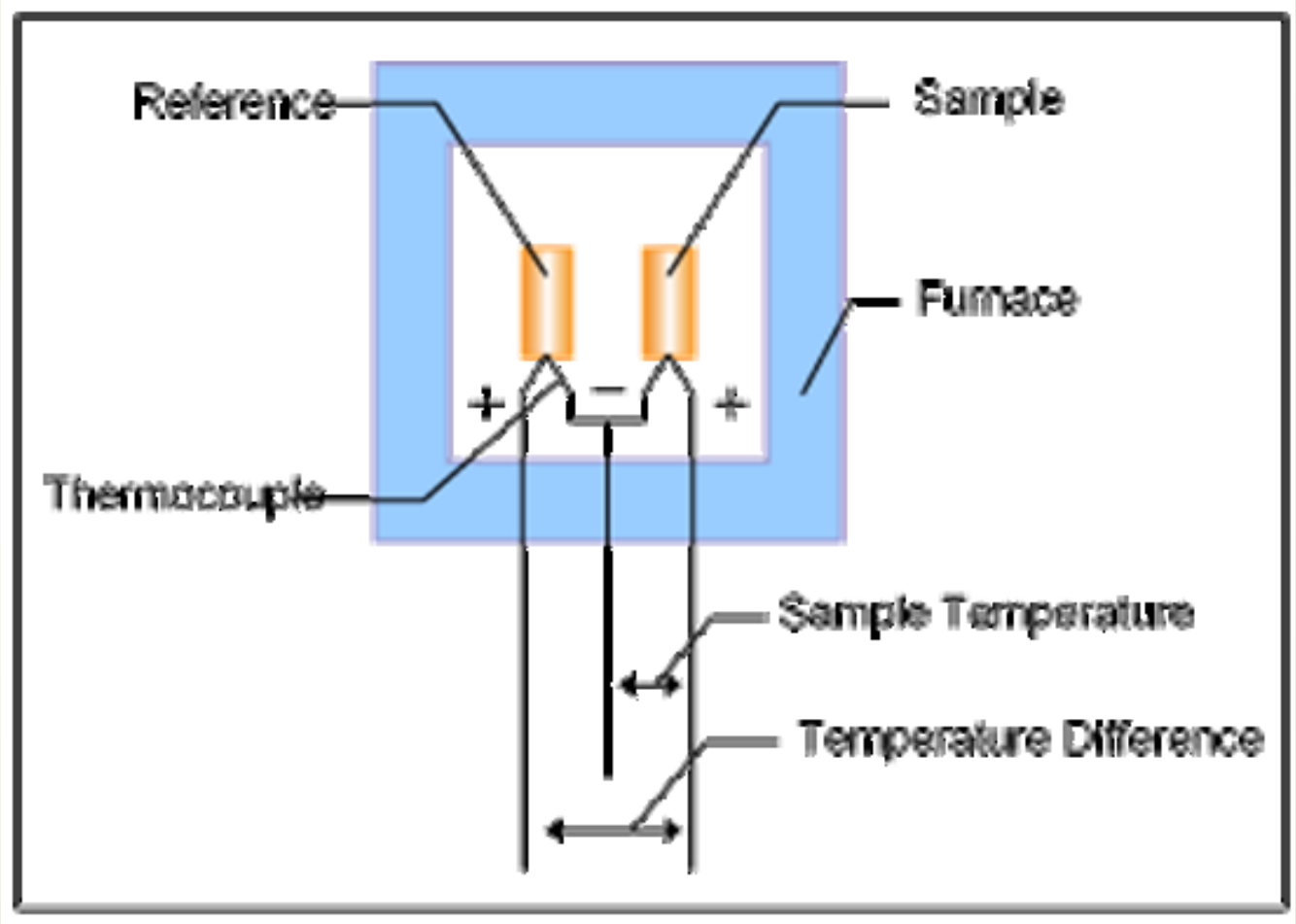
آنالیزهای حرارتی

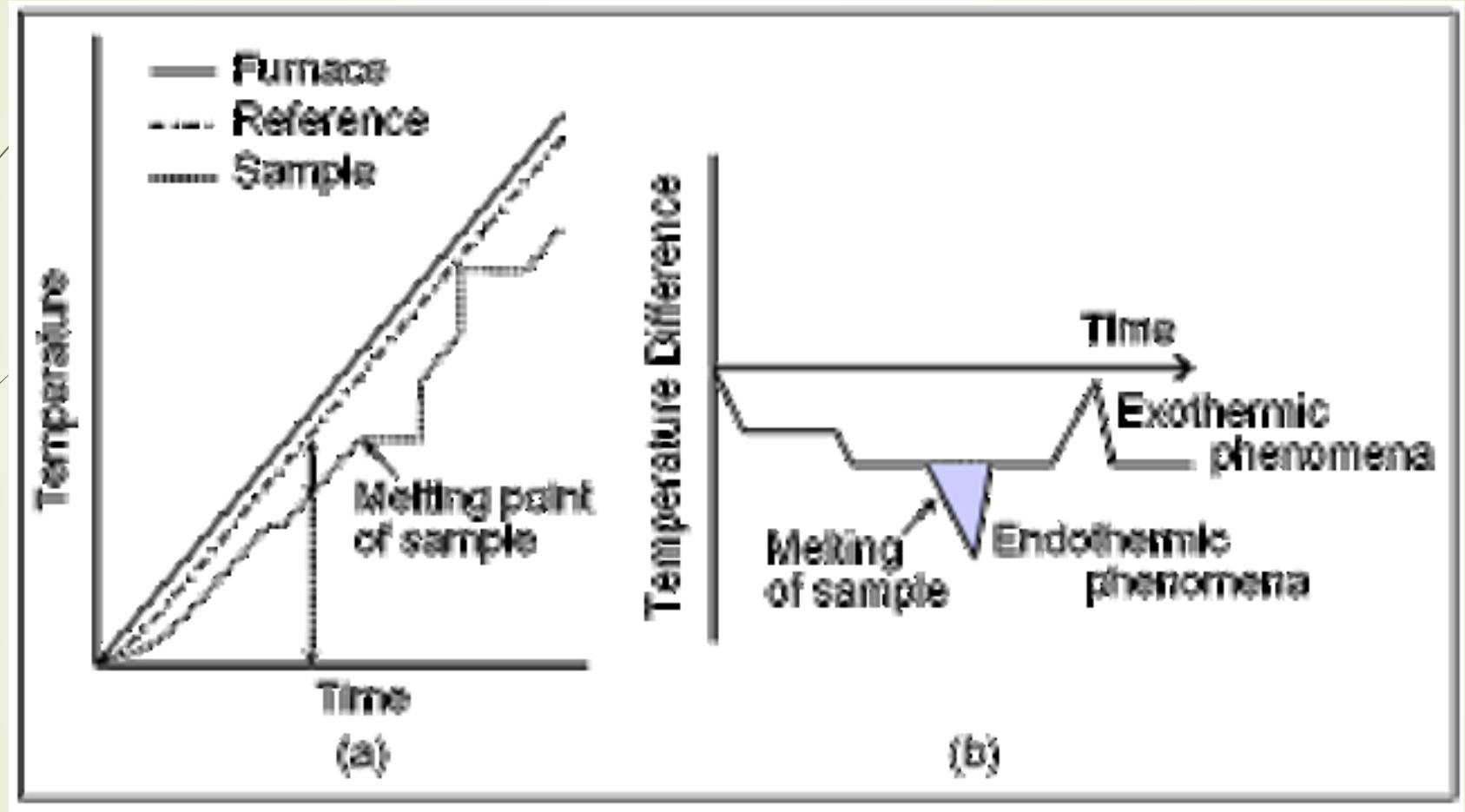
آنالیز افتراق حرارتی DTA و توزین حرارتی TGA

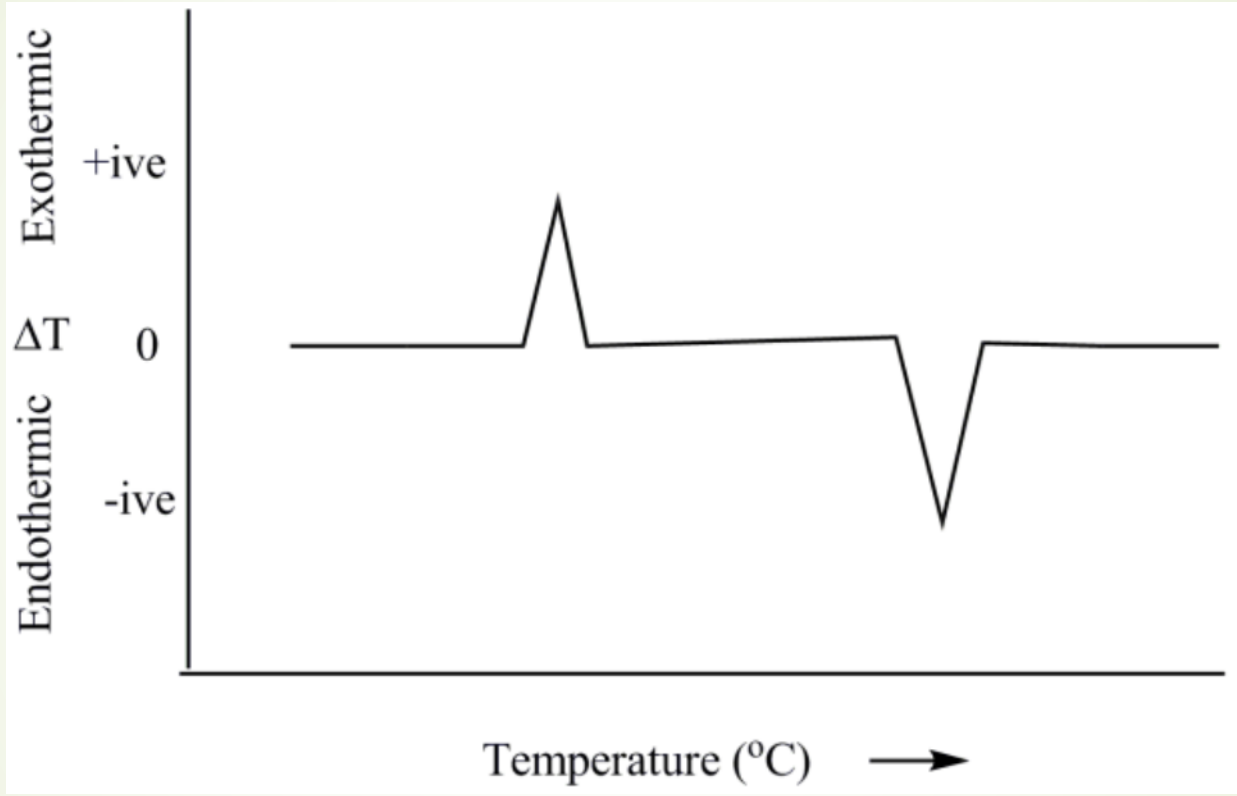
کالری سنجی روبشی افتراقی STA و دیلاتومتری

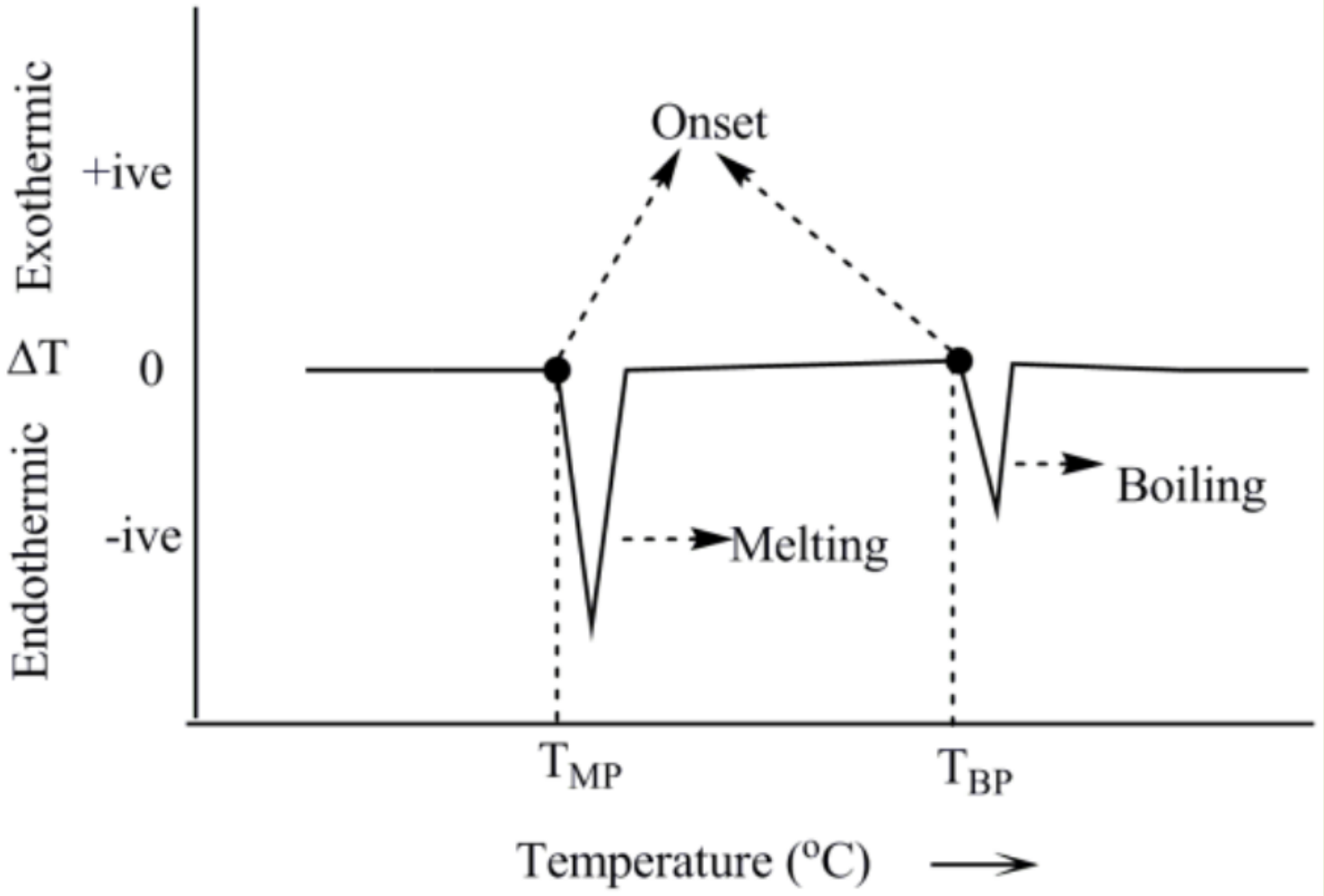

Detection signal
Detector
Data Processing
Sample temperature
Sample
Tem. control
Furnace
Control signal
Computer Unit
Detection Unit

Differential Thermal Analysis

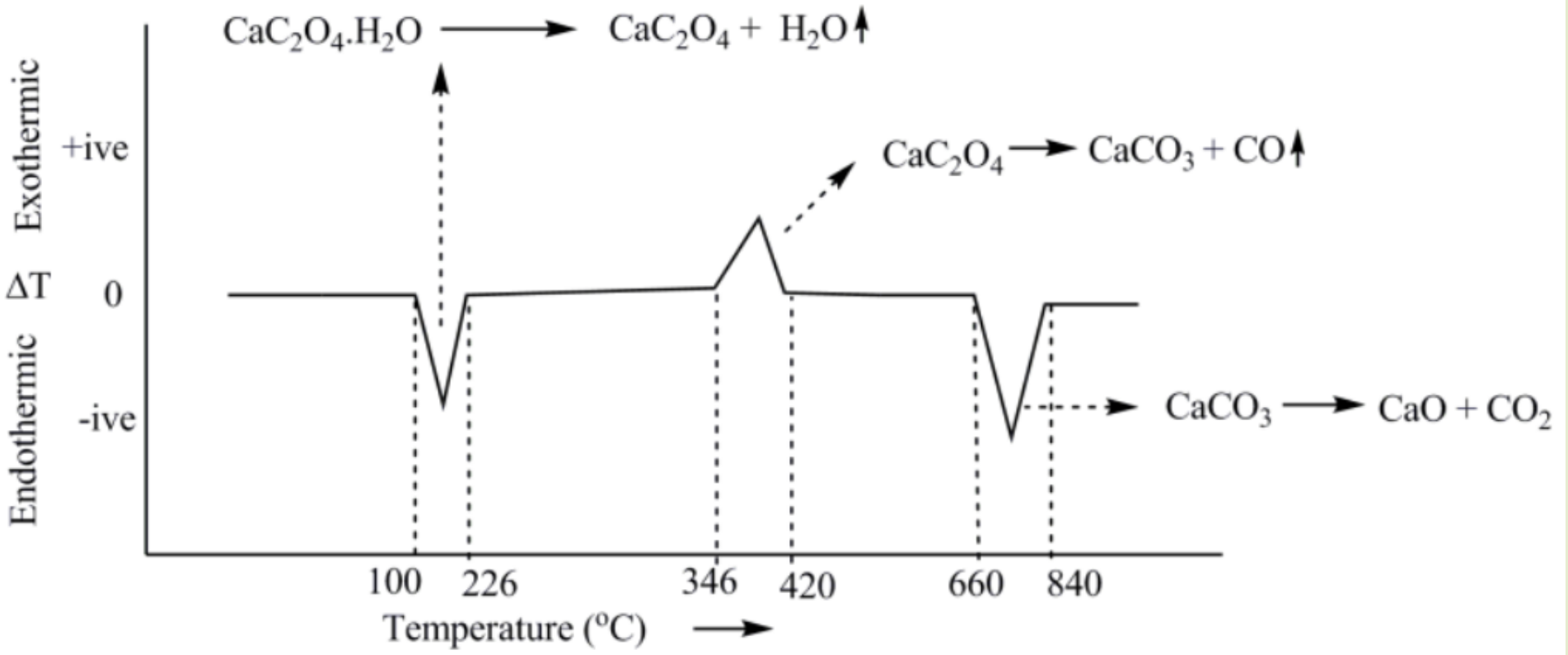



Furnace
Reference
Sample
Temperature
Melting point of sample
Time
(a)
Temperature Difference
Time
Exothermic phenomena
Melting of sample
Endothermic phenomena
(b)

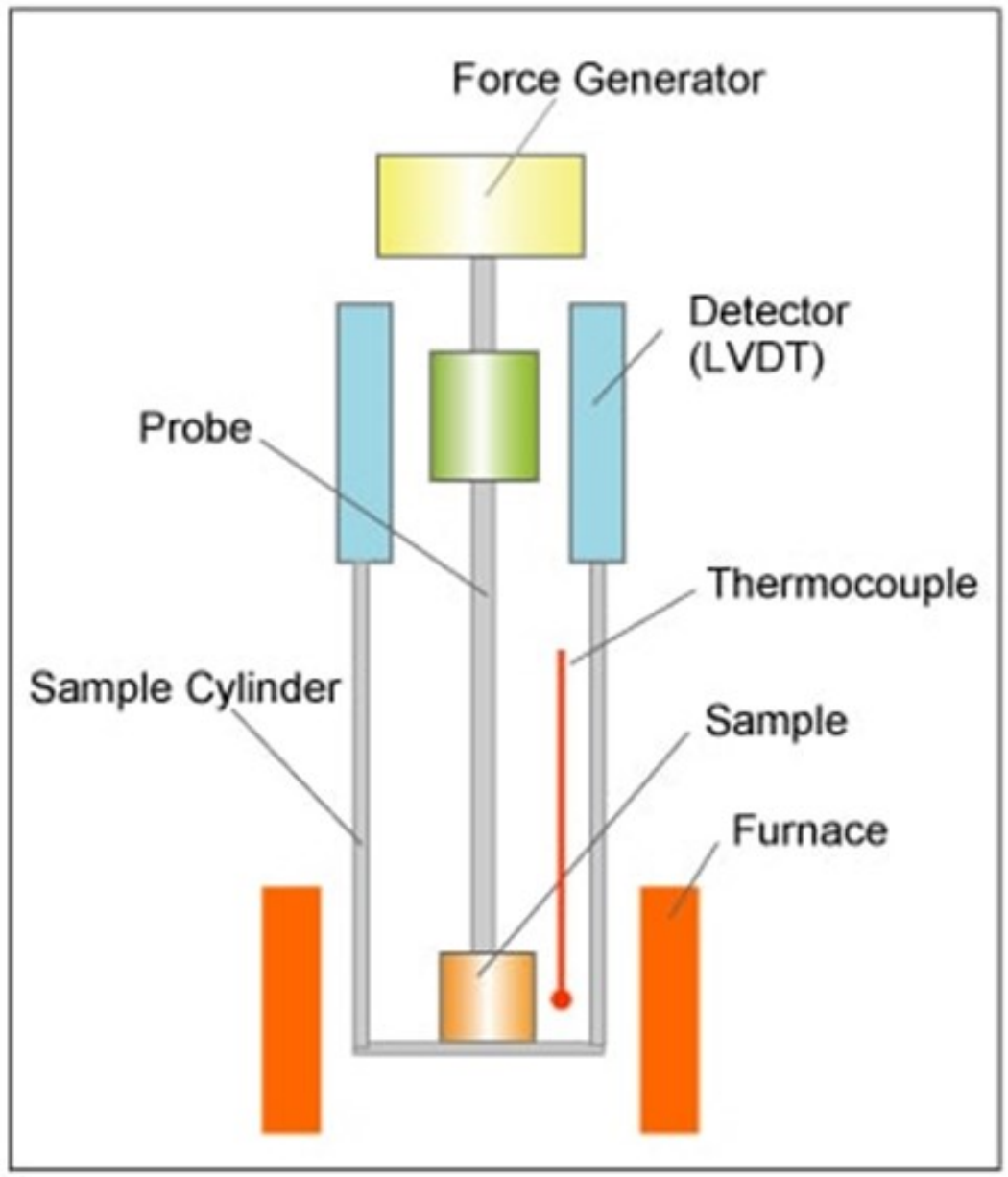

Exothermic
+ive
ΔT
0
Endothermic
-ive
Temperature (°C)

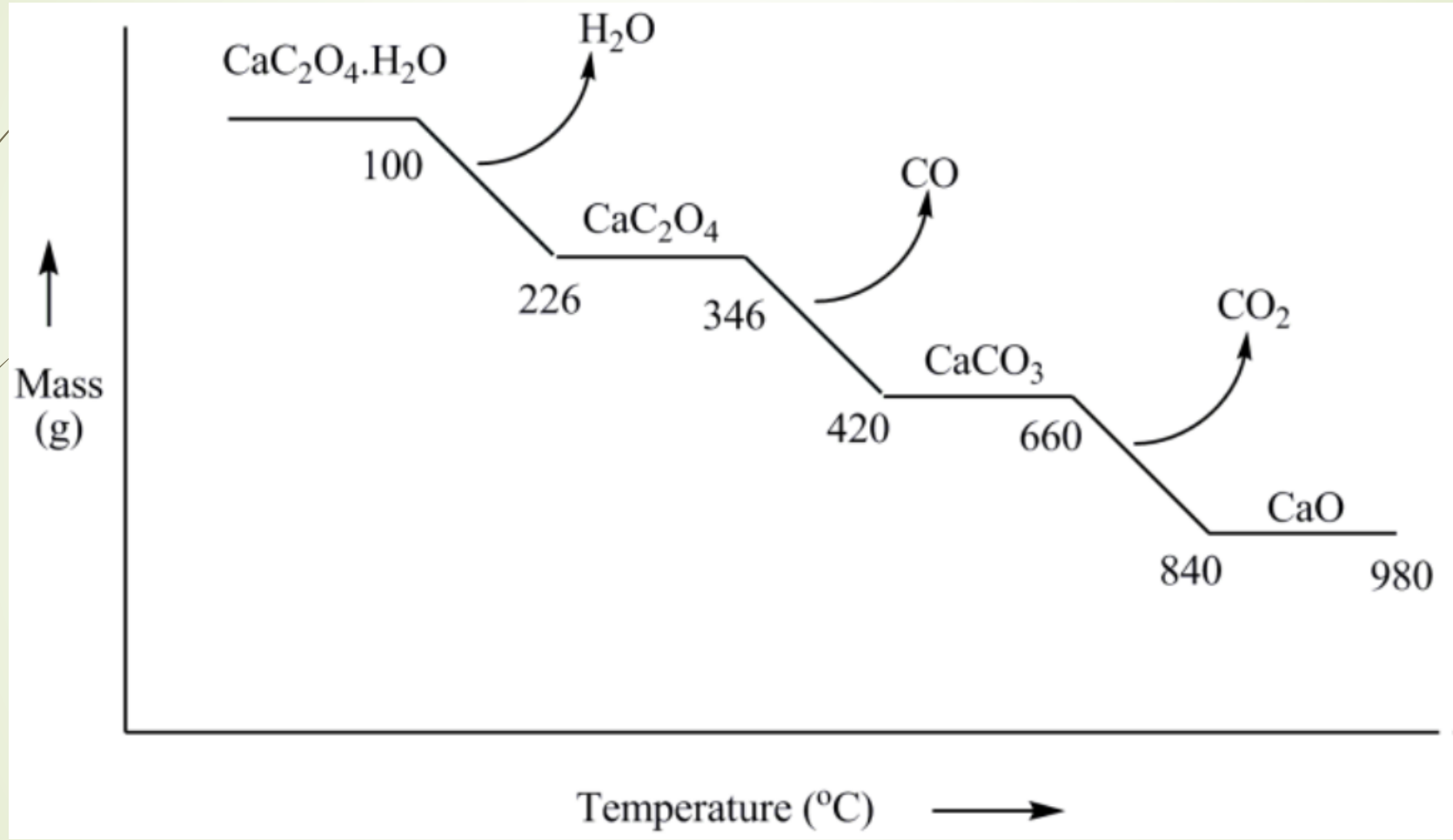

Exothermic
+ive
ΔT
0
Endothermic
-ive
Onset
Melting
Boiling
T_{MP}
T_{BP}
Temperature (°C)

calcium oxalate monohydrate $CaC_2O_4.H_2O$

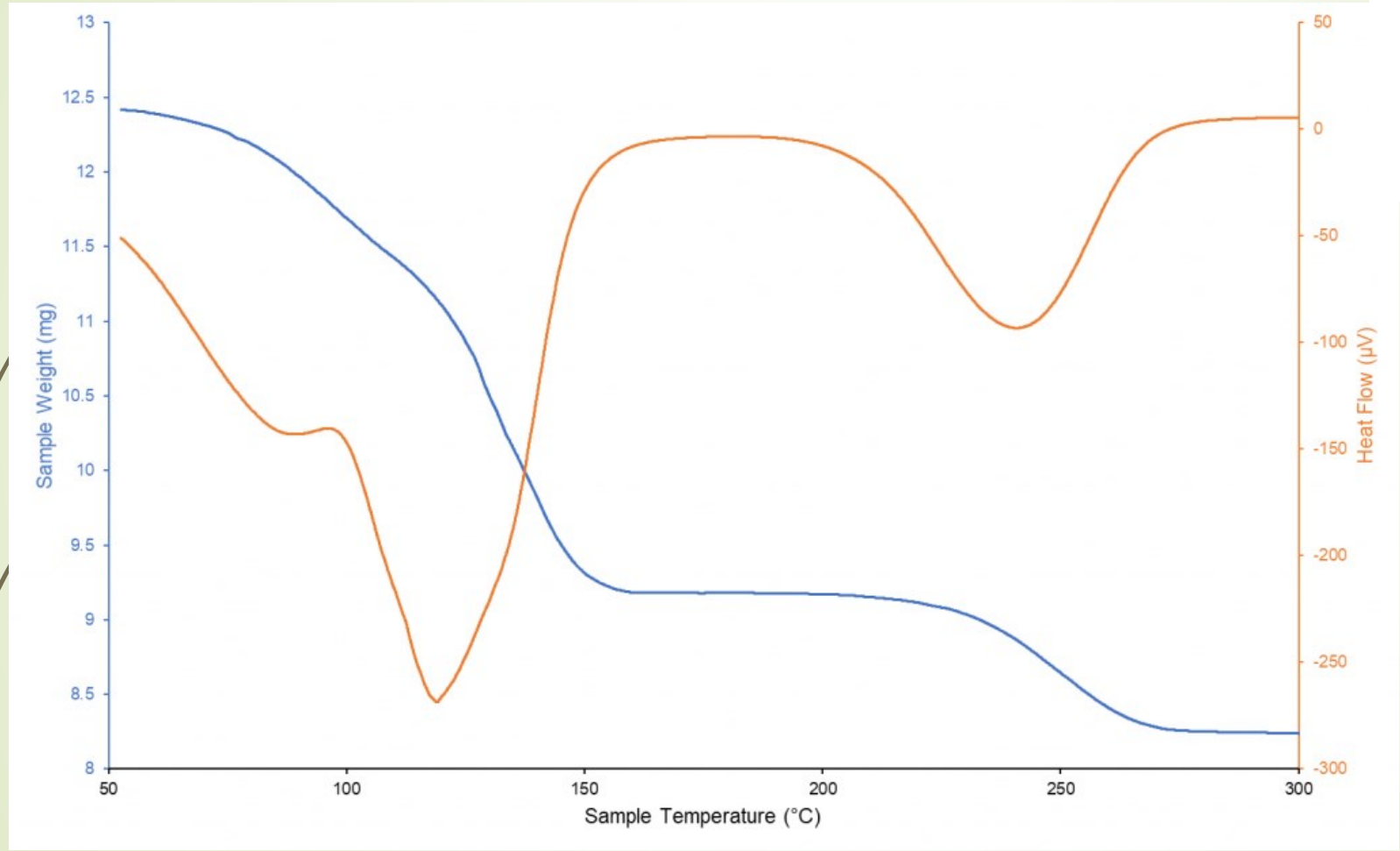


Thermal Gravimetric Analysis



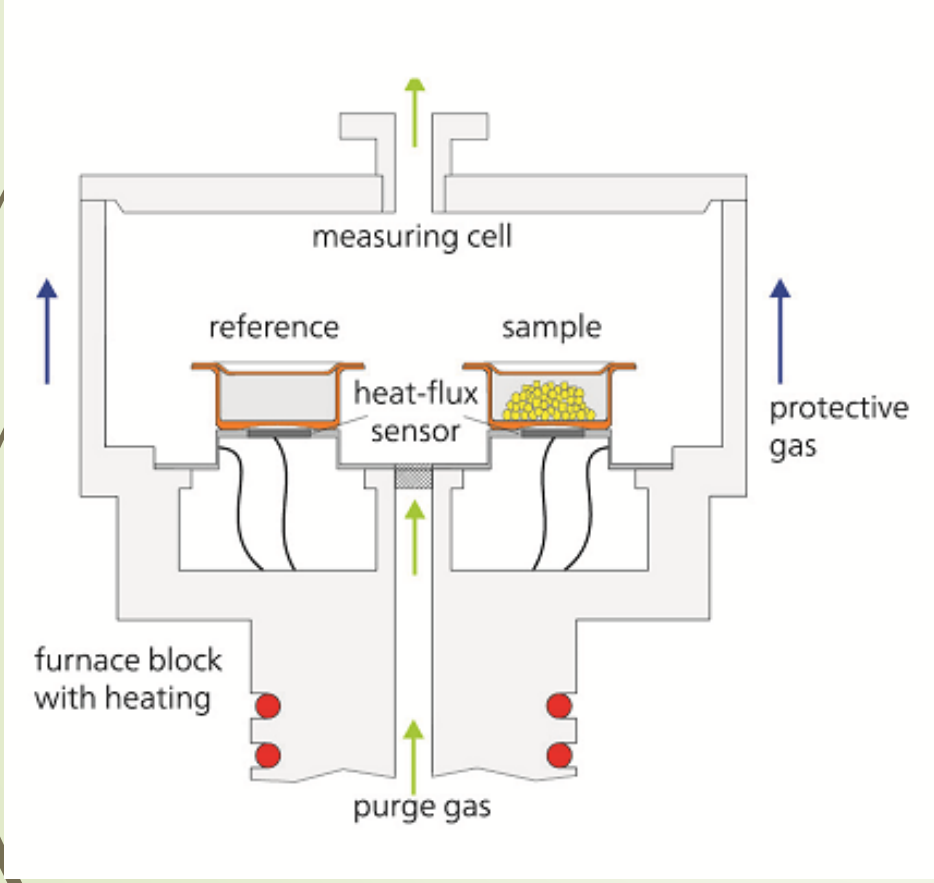

$CaC_2O_4.H_2O$
H_2O
100
CaC_2O_4
CO
226
346
$CaCO_3$
CO_2
420
660
CaO
840
980
Mass (g)
Temperature (°C)

$CuSO_4.5H_2O$

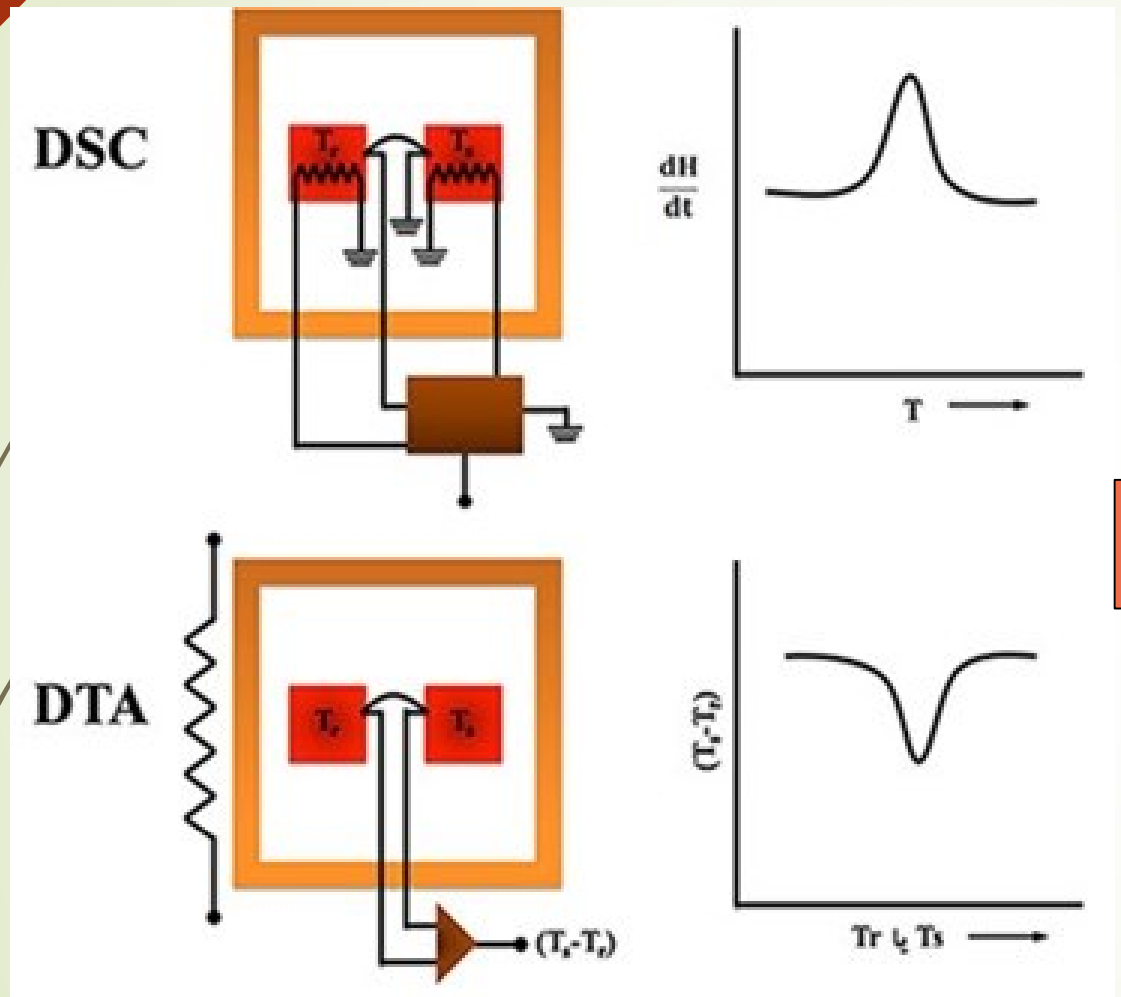

Sample Weight (mg)
Heat Flow (µV)
Sample Temperature (°C)
13
12.5
12
11.5
11
10.5
10
9.5
9
8.5
8
50
0
-50
-100
-150
-200
-250
-300
50
100
150
200
250
300

Differential Scanning Calorimetry (DSC)
کالری سنجی روبشی افتراقی

- در هردو اختلاف دمای نمونه و مرجع برحسب μV اندازه گیری می شود.
- در DTA مبنا همان اختلاف دما است برای تحلیل و بدست آمردن دمای رویداد ها مفید است.
- در DSC با کالیبره کردن مناسب از همان اختلاف دما مقدار اختلاف شار حرارتی نمونه و مرجع گزارش می شود.



heat of fusion
heat of crystallization

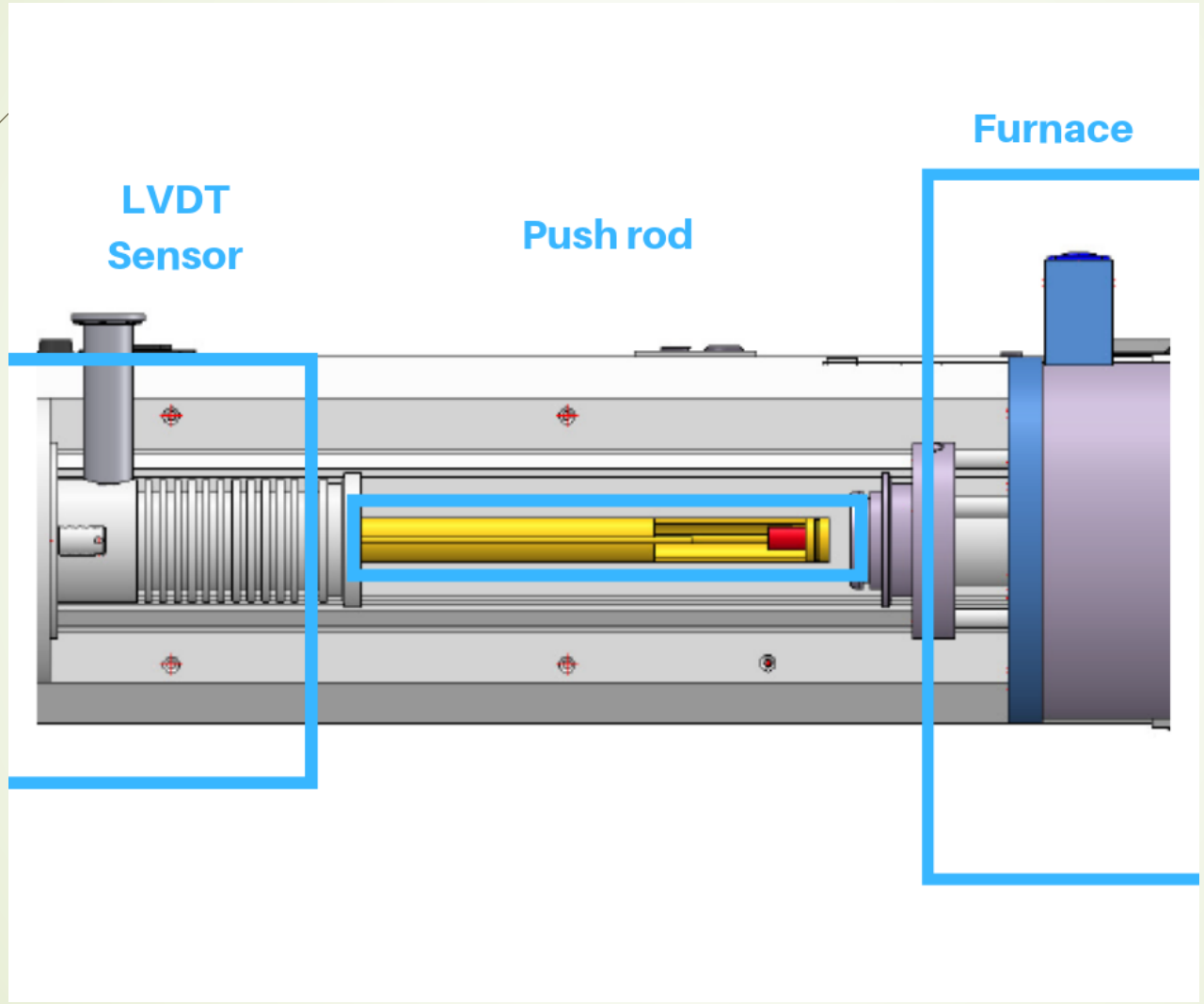


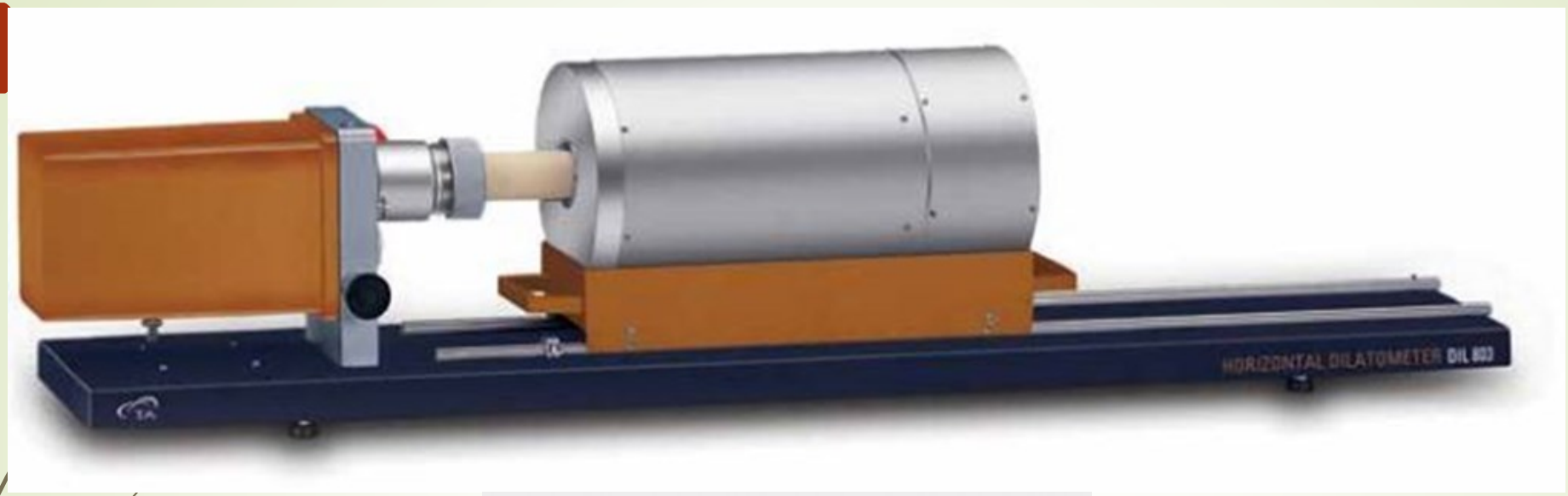
$$Heat\ Flow = \frac{Heat}{Time} = \frac{q}{t}$$

$$Heating\ Rate\ = \frac{Temperature\ increase}{Time} = \frac{\Delta T}{t}$$

$$\frac{\frac{q}{t}}{\frac{\Delta T}{t}} = \frac{q}{\Delta T} = c_p$$

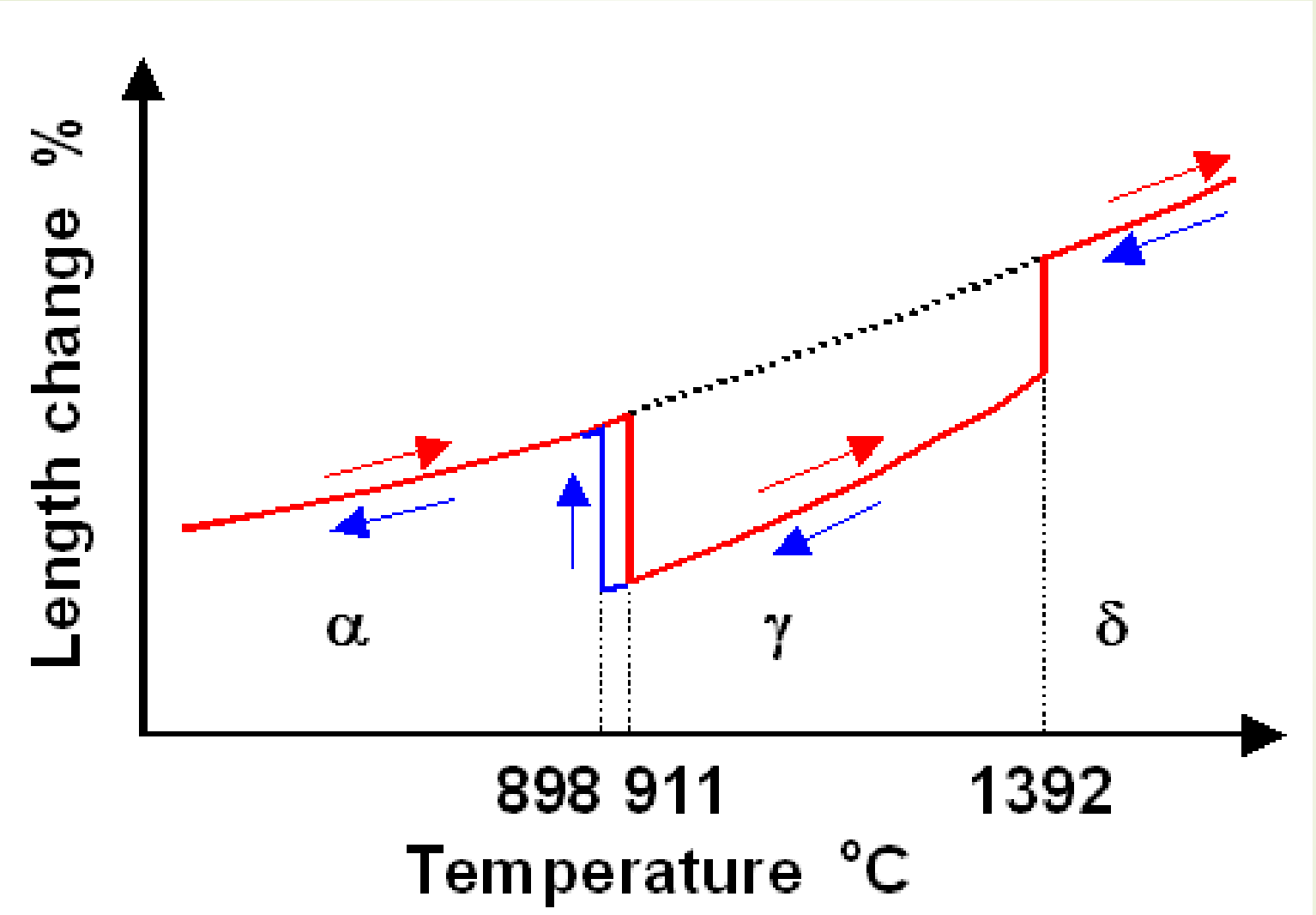
Dilatomery (DIL)





$$\alpha = \frac{1}{L_0}\left(\frac{\Delta L}{\Delta T}\right)$$

α	Coefficient of expansion
L_0	Initial sample length
ΔT	Change in temperature
ΔL	Change in length


Length change %
α
γ
δ
898 911
1392
Temperature °C

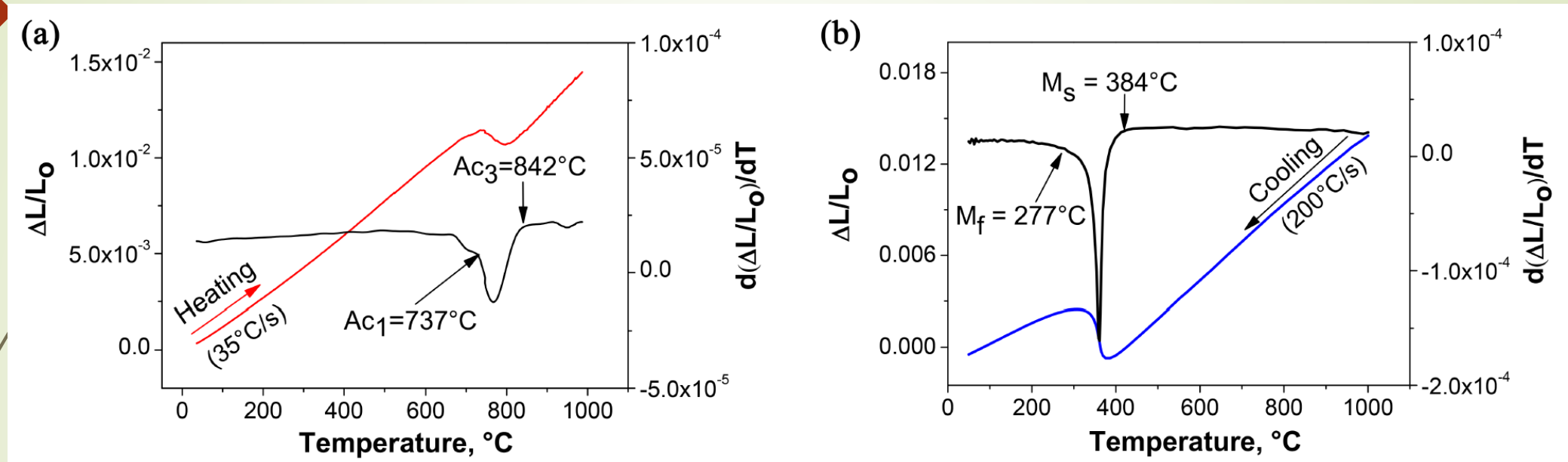


Figure 2. Dilatometric curves showing the experimental determination of the critical transformation temperatures: (**a**) description of the determination of Ac_1 and Ac_3 in continuous heating at 35 °C/s; (**b**) description of the determination of M_s and M_f in cooling at 200 °C/s.

Ac1 represents the critical **temperature** at which pearlite transforms to austenite during heating; **Ac3** represents the final critical **temperature** at which free ferrite is completely transformed into austenite during heating.

Applications

Thermal expansion coefficient

Phase transitions

Sintering temperatures

glass transition temperature.

density change

softening point