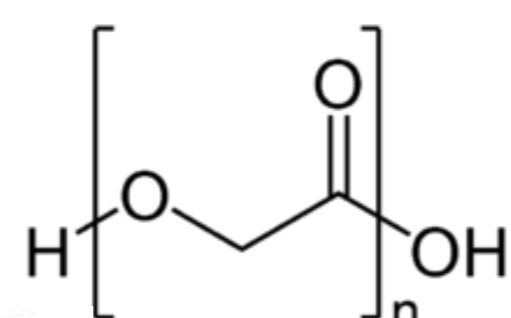


1. Introduction

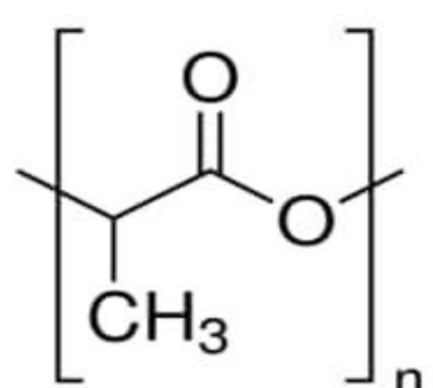
While plastics have made our daily lives more convenient due to their high functionality, they are associated with waste disposal problems, increase of marine plastic pollution, climate change and pose global issues. With this issue at hand, the production and use of biodegradable plastics has increased. Conventional thermal analysis methods pay attention to the type of gas as the atmosphere and its flow rate, but tend to ignore the effects of humidity. However, the actual measurement results are provided by indoor air which includes humidity. Humidity affects dehydration reaction, adsorption, hydrolysis, etc. in some cases, it is necessary to control humidity during measurement. Using the humidity generator, Rigaku HUM-1, STA8122 and TMA8311 can be performed under any water vapor concentration.

3. Materials

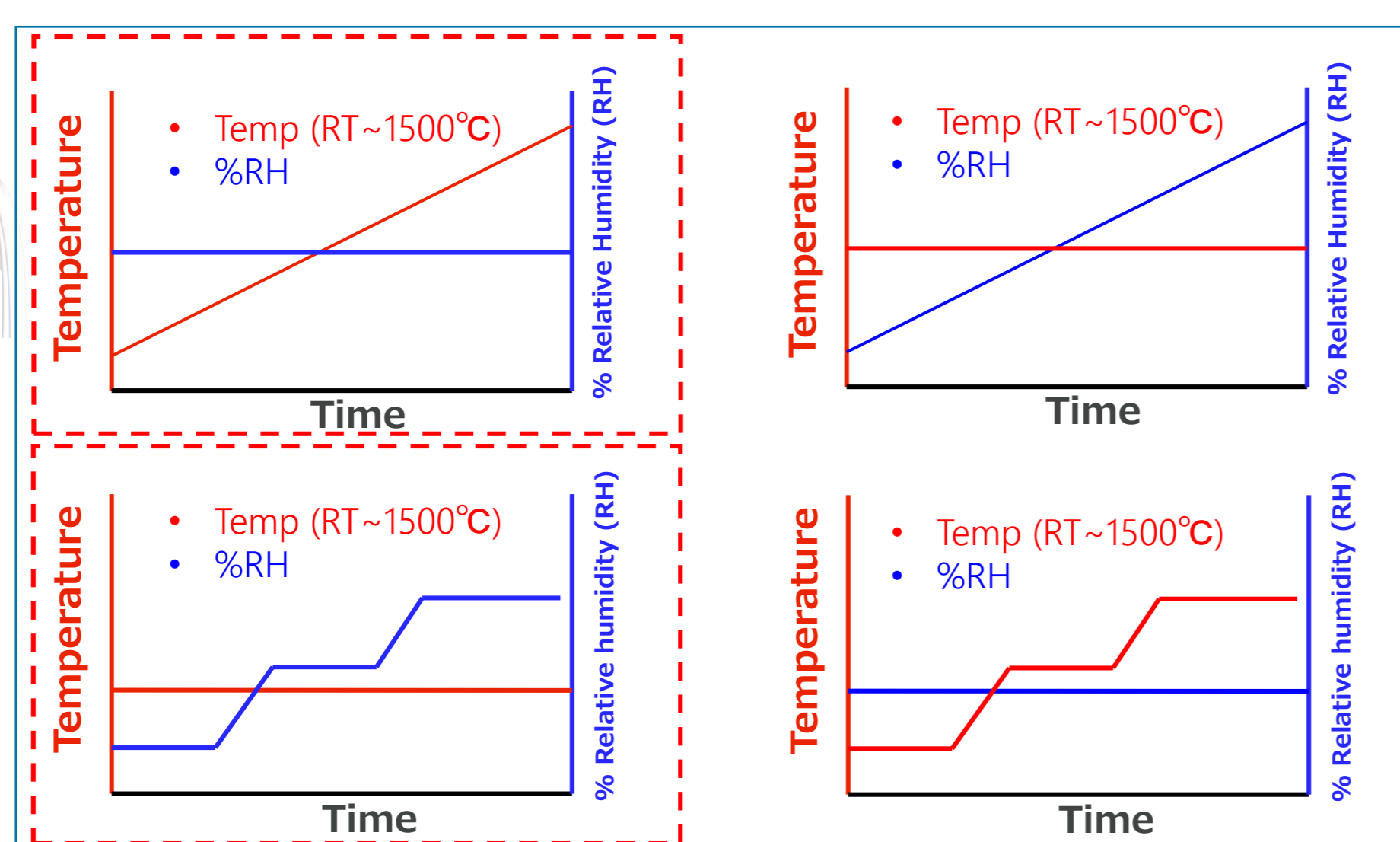
Polyglycolide or poly(glycolic acid) (PGA)



Poly(D,L-Lactide) (PDL-Lactide)

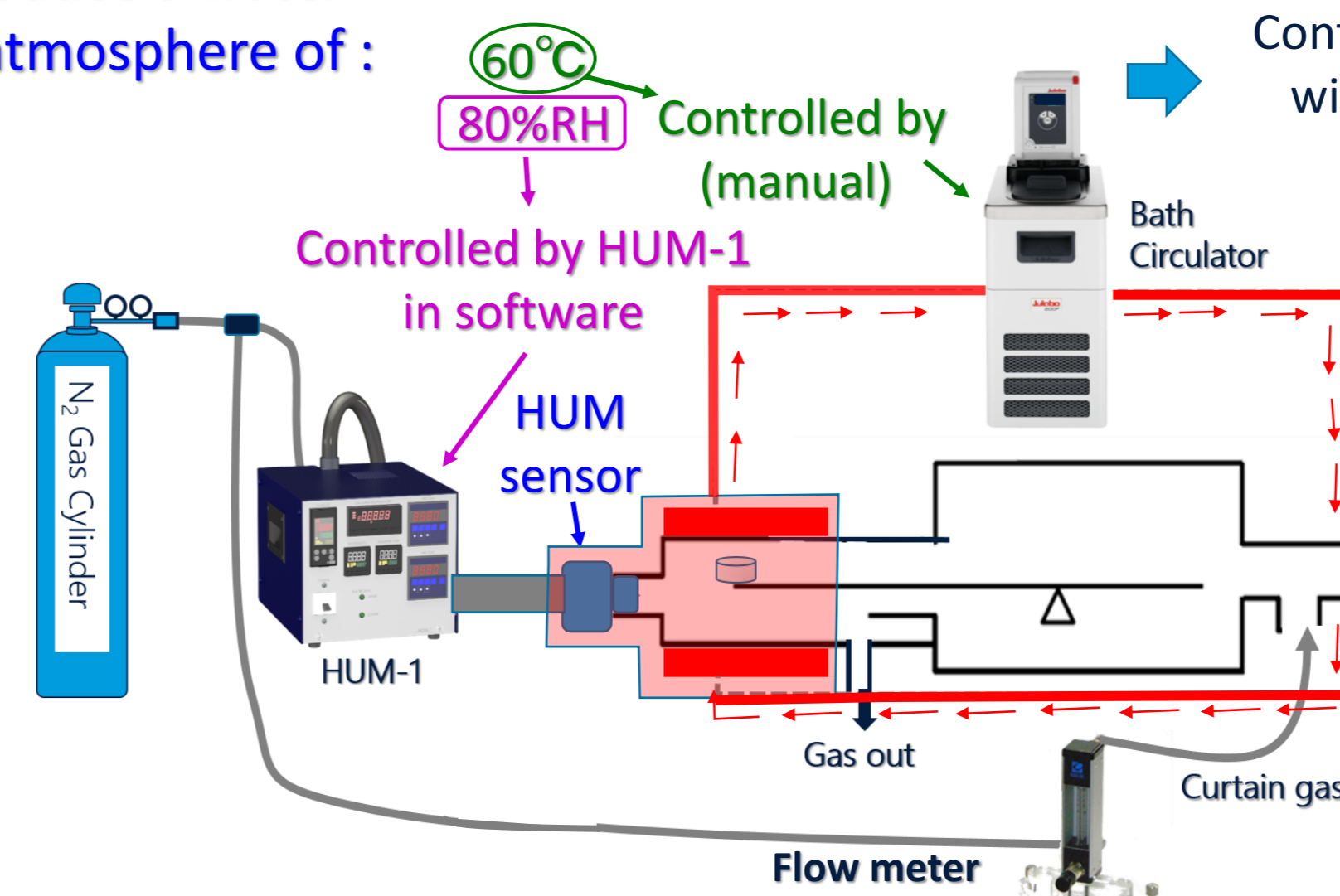


4. Methodology



➤ High concentration of water vapor atmosphere such as >25°C~85°C 0~90%RH

For example if you want to produce a water vapor atmosphere of:



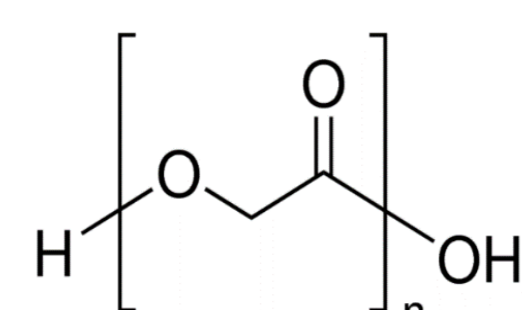
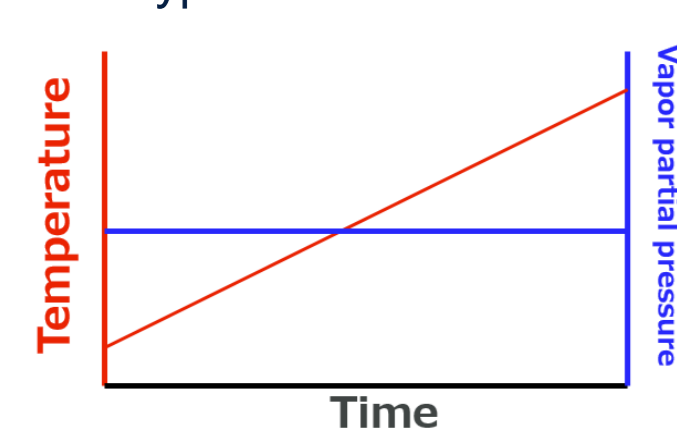
This type of combination uses a HUM-1 dedicated furnace.

Thermo Plus EVO2 STA8122 Horizontal differential type (RT~1400°C)

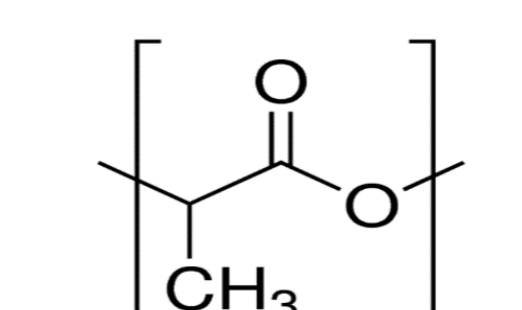
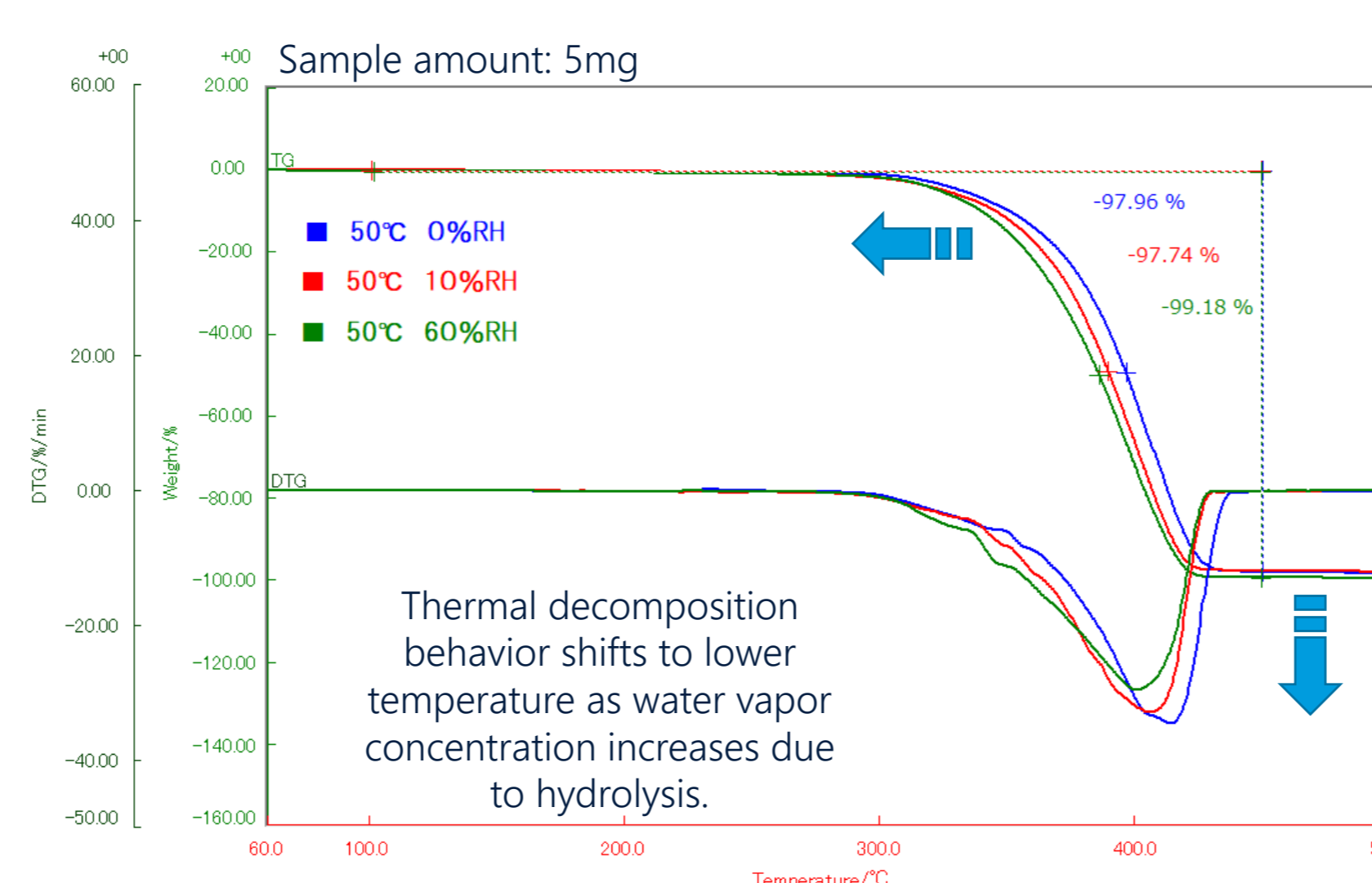
4. Results and Discussion

4-1. HUM-STA Application: Thermal decomposition behavior of polyglycolide (PGA) and PDL-lactide

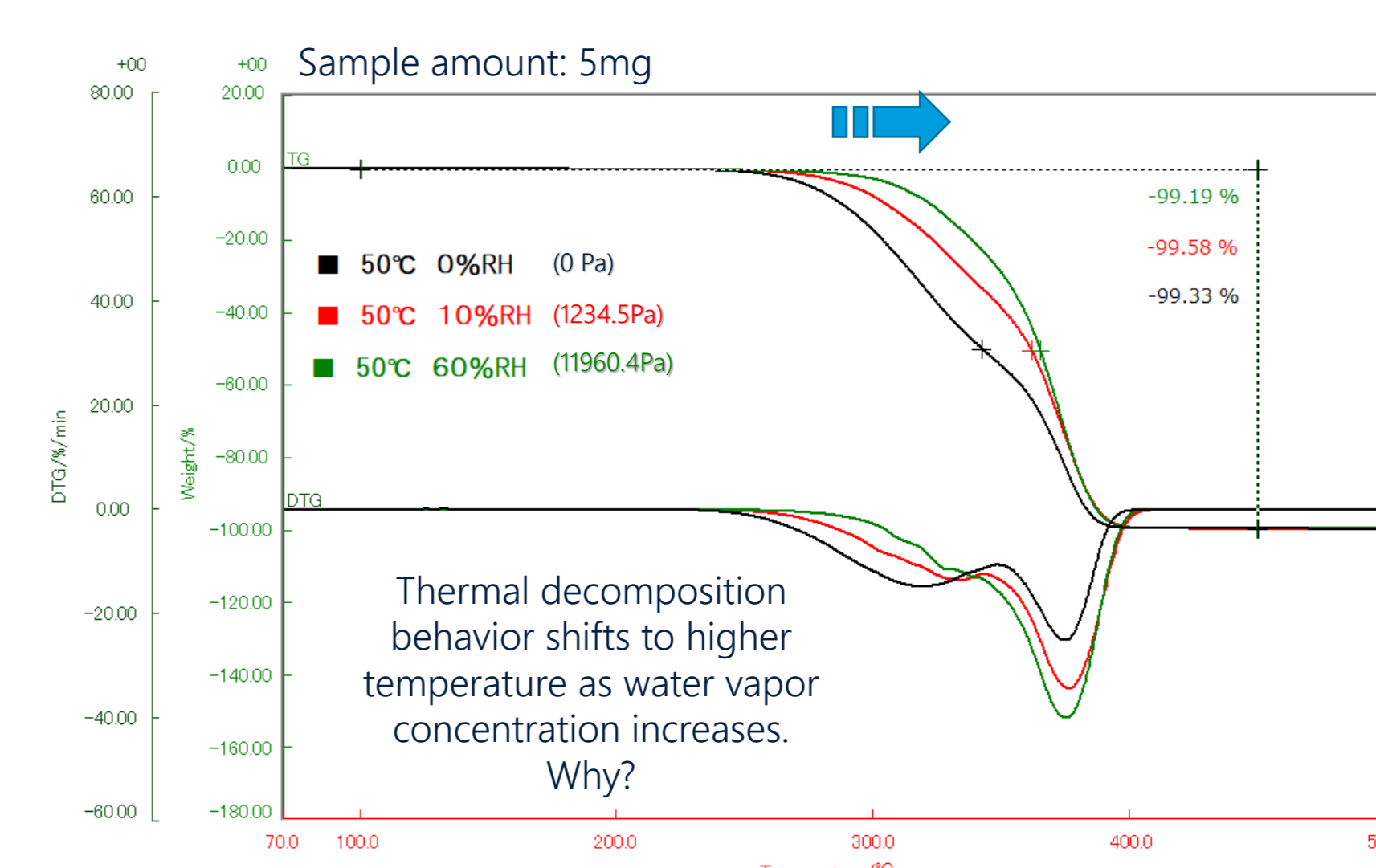
Type of measurement



Polyglycolide structure



Poly-D,L-lactide structure



4-2. HUM-STA-MS Application: Thermal decomposition behavior of PDL-lactide

Conditions:
Sample amount: 1mg
Temperature range: RT~600°C
Mass range: m/z20~500
Ionization mode: Electron ionization
Humidity conditions:
1. 25°C, 80% RH (2534Pa)
2. 25°C, 0%RH

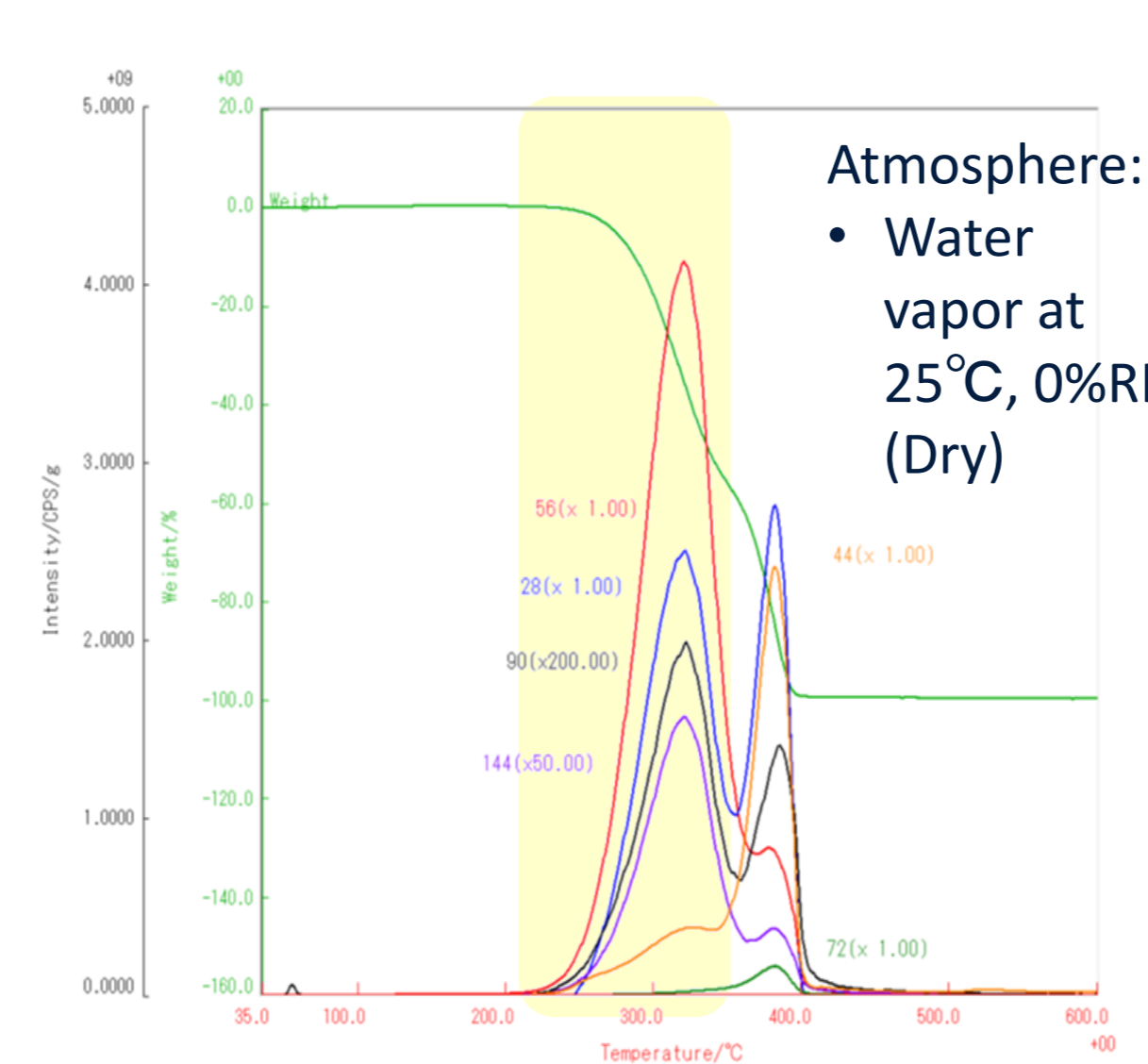
Thermo plus EVO2 HUM-1 Humidity range: 25°C, 0%RH~80%RH

He gas

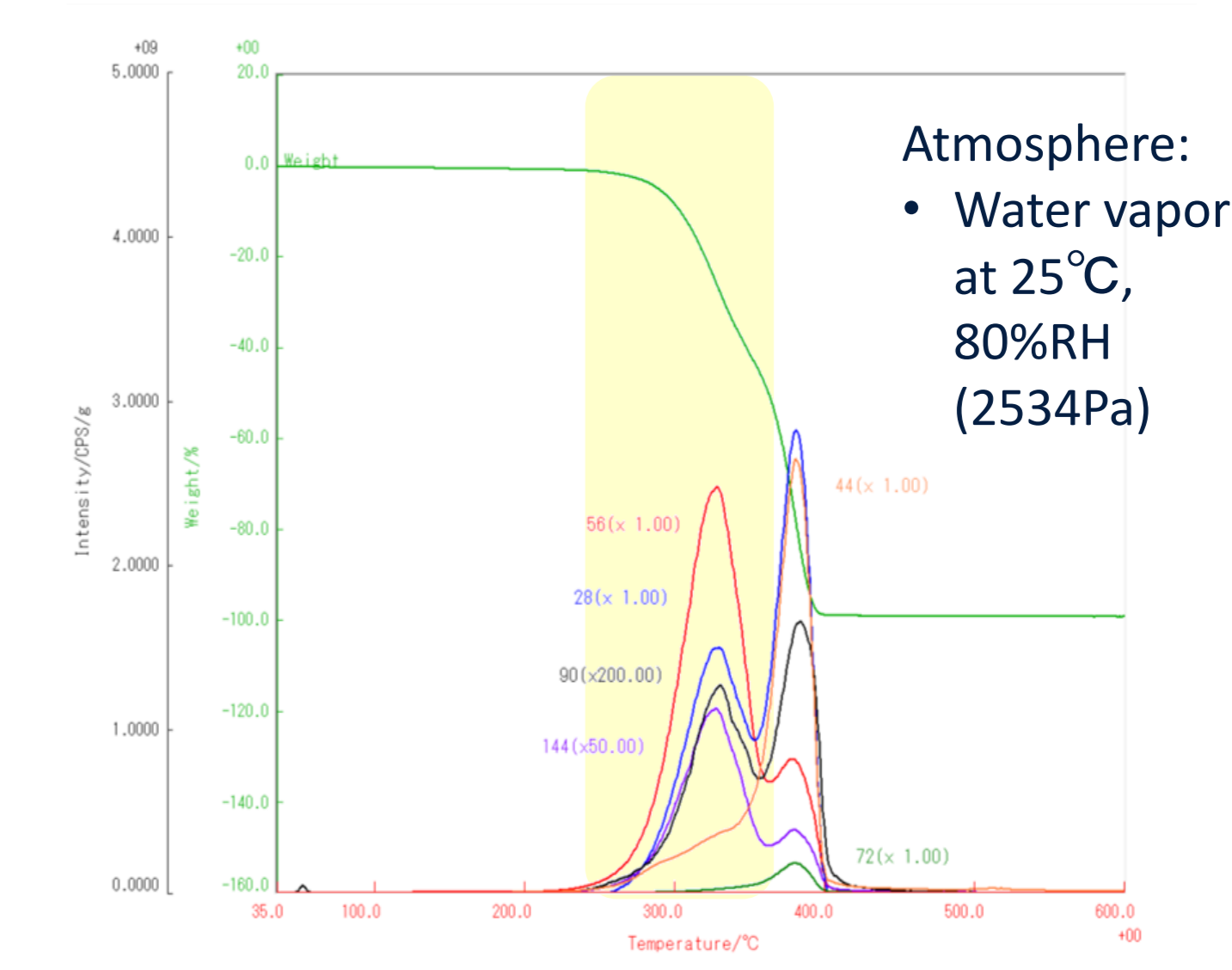


GC/MS manufactured by Shimadzu, JEOL, etc.

STA8122 (RT~1500°C)



m/z28 ethylene m/z44 acetaldehyde m/z56 acrolein m/z72 acrylic acid m/z90 lactic acid m/z144 lactide



5. Conclusion

1. The thermal decomposition behavior of PGA shifts to lower temperature and also the residue has decreased as water vapor concentration increases. This is due to hydrolysis.
2. The opposite of PGA, the thermal decomposition behavior of PDL-lactide shifts to the high temperature side when the water vapor concentration increases. Using the HUM-STA-MS, we can determine which evolved gases that were evolved in these changing atmosphere or which evolved gases were highly affected by the change in water vapor atmosphere.