THIN FILM RESEARCH LABORATORY

GCM **NEWSLETTER**

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ÉCOLE POLYTECHNIQUE MONTRÉAL

Université de Montréal

ADVANCED MATERIALS ANALYSIS COURSE AT YOUR COMPANY PREMISES

With the start of the 2010 academic year, the GCM offers a range of courses on the analysis of materials, which can be given in your company. Lasting either half a day or a full day, these courses are aimed principally at an industrial audience, and include many examples of applications. The following courses are available for Fall, 2010:

a) Introduction to the analysis of composition and surface contaminants by XPS and TOF-SIMS

b) Surface analysis for industry: the major spectroscopic techniques

c) Introduction to FTIR and Raman (i.e., vibrational) spectroscopies, versatile tools for materials characterization (available from November)

d) Introduction to atomic force microscopy (AFM)

e) The atomic force microscopy for industry (available from November)

5 reasons for taking these courses:

- **Credibility:** These courses are taught by members of accredited institutions, the University of Montreal and École Polytechnique.
- **Expertise:** They are specialists, who have years of experience on these techniques in which they share their knowledge.
- **Proximity:** These GCM courses are offered on the premises of your business.
- **Adapted:** The content has been adapted to non-academic audiences, with an emphasis on applications.
- **Affordable:** These courses provide substantial savings by avoiding travel and accommodation for participants.

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THERMOGRAVIMETRIC ANALYSIS (TGA): WHEN THE HEAT IS ON!

In collaboration with Sylvain Essiembre, research officer at the Université de Montréal

Theromgravimetric analysis, also known by its English acronym, TGA, measures the change in the mass of a sample as a function of the temperature in a controlled atmosphere, usually consisting of nitrogen or air. When a material is heated, it can lose mass by several processes, such as drying or chemical reactions releasing gases. A knowledge of the thermal behavior of a sample will ensure, for example, that it is used at a temperature range guaranteeing its chemical stability.

Typical Application

The TGA is widely used in many scientific fields, particularly in the areas of pharmaceuticals and polymers, to determine sample degradation temperatures, moisture content, decomposition kinetics, thermal stability, etc. Scientists in the pharmaceutical field, for example, routinely analyze the thermodynamic parameters of drug candidates. TGA analysis may well reveal the decomposition temperature of the hydrate or the number of water molecules in the crystal structure.

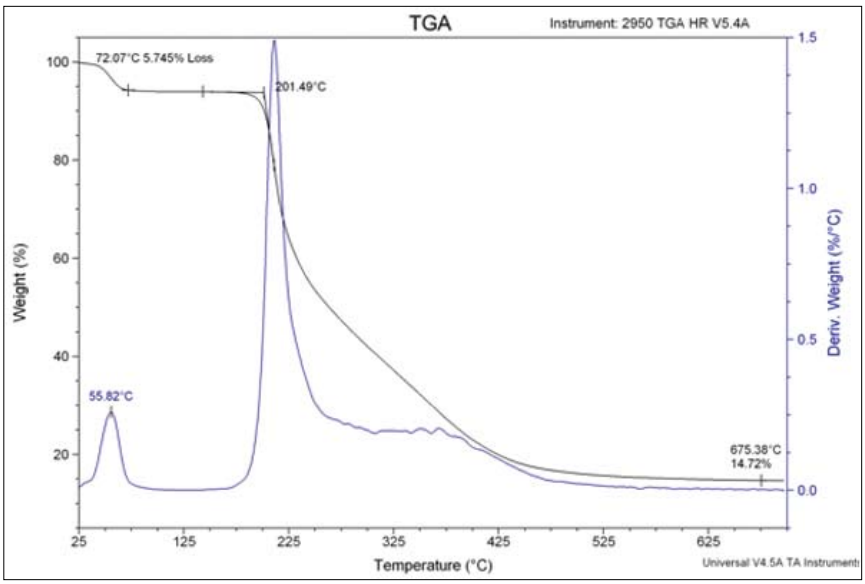

***Figure 1:** Example of TGA with mass variation in black and the derivative of mass change in blue*

Heat please!

A TGA analysis is based on the measurement of three parameters: mass, temperature and time. The apparatus includes a microbalance on which the sample is placed, a controlled atmosphere chamber and a thermocouple to measure temperature accurately. The chamber is purged with either an inert gas, to prevent oxidation or other adverse reactions, or with air, to simulate degradation under normal atmosphere storage.

Several modern TGAs can reach 1000 °C or more. Any mass loss for temperatures below room temperature has already occurred before the measurement, so that mass losses are studied from 25 °C upward. The analysis of mass loss takes place either by varying the temperature gradually or leaving the sample at a given temperature, to determine its stability. Typically, measurements are performed by a TGA scan at a constant temperature ramp rate; typical rates used are 10-20 °C per minute. The reactions leading to mass loss or evaporation can be studied with greater resolution by using a combination of constant temperature scans and slow heating rates, using the automated analysis of loss rates. Several temperature programs, with pauses, are also possible to simulate the temperature variations for a given process.

THE TGA IN A FEW WORDS:

- Result: Percentage of the initial mass as a function of temperature or time
- Typical temperature range: 25 °C to 900 °C.
- Sample mass: 2 mg to 20 mg
- Scale sensitivity: mass ± 0.001 mg.

Sylvain Essiembre received his B.Sc. in Chemistry in 2000 at UQAM. He worked in hazardous materials management and then undertook a Master's degree in electrochemistry at UQAM, in collaboration with the University of Montreal. Since 2006, he has worked as a physical chemist at the Laboratory of Polymer Materials Characterization, of the Chemistry Department of Université de Montréal. He is in charge of thermal techniques, such as DSC, TGA, X-ray diffraction, measurements of thermomechanical properties, etc. He developed his expertise, with the help of departmental professors, in the area of polymer materials and, eventually, of solids and liquids. Since 2008, he deals with TGA and DSC measurements for the GCM. He also received a BBA in PME management at the HEC, in 1990, and has spent seven years in administration.