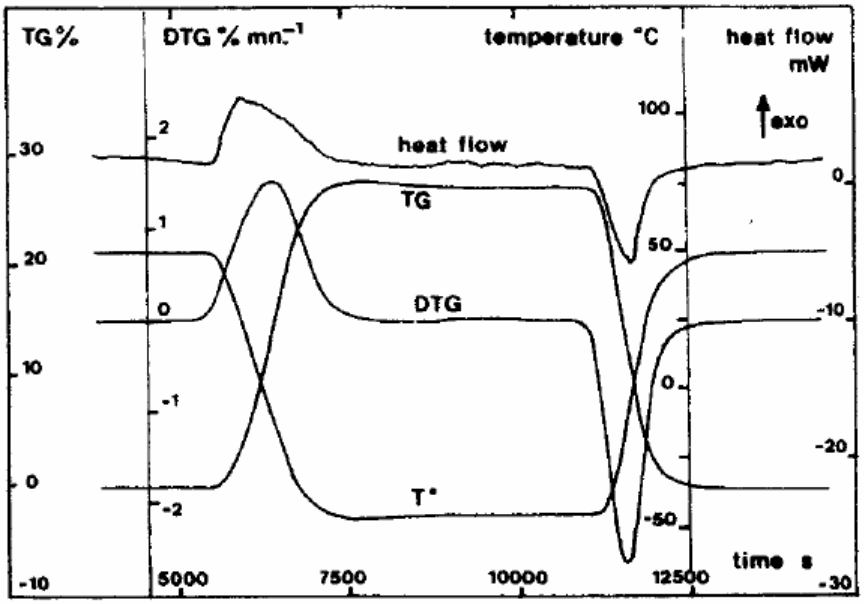
Adsorption and desorption of CO_2 on active coal

Introduction

Capture of carbon dioxide from fossil fuel power plants via adsorption and sequestration of carbon dioxide in unmineable coal seams are achievable near-term methods of the reducing atmospheric emissions of this greenhouse gas. The evaluation of CO_2 adsorption and desorption characteristics on finely crushed and uncrushed samples is critical for CO_2 sequestration in coal beds.

The TG-DSC technique is the ideal tool for such investigations:

- the thermogravimetric signal provides the amount of CO_2 adsorbed or desorbed on the coal sample
- the DSC signal measures the corresponding enthalpy: exothermic during adsorption (that means an increase of the temperature during the sequestration process) or endothermic during the desorption (that means cooling of the coal material)



Experimental

Sample: active coal
Mass: 29.1 mg
Temperature range: -50 °C to 50 °C
Atmosphere: CO_2

Results and conclusions

The sample of active coal is cooled down from 50 °C to -50 °C, then maintained at -50 °C during more than one hour before reheated at 50 °C under pure CO_2.

The TG curve shows the mass increase of the sample corresponding to the CO_2 adsorption. The saturation of the sample is obtained during the isothermal step at -50 °C.

When heating the mass loss on the TG curve indicates the CO_2 desorption. It is noticed that the desorption is not complete.

The DTG curves give an information on the rate of CO_2 adsorption and desorption.

On the DSC curve, the CO_2 adsorption corresponds to an exothermic effect and the desorption to an endothermic effect.

With such a TG-DSC experiment, it is possible to determine the corresponding enthalpies of adsorption or desorption versus the amount of CO_2 adsorbed or desorbed on the sample.

SENSYS evo TG-DSC
-120°C to 830°C

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