# A NEW APPROACH TO THE MEASUREMENT OF DIELECTRIC PROPERTIES AS A FUNCTION OF TEMPERATURE - MICROWAVE DIELECTRIC THERMAL ANALYSIS (MDTA)

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Microwave Thermal Analysis (MWTA) [1] is a rapidly developing group of techniques in the important area of materials processing and characterisation using microwave radiation. The fundamental principle of these techniques is that the dielectric constant changes considerably not only with temperature but also very significantly when chemical or physical changes occur in the sample [2]. The new technique of Microwave Dielectric Thermal Analysis (MDTA), which we present here, involves the measurement of the dielectric properties of materials in a quasi-simultaneous manner with temperature whilst heated in a strong microwave field. The object is to be able to predict the microwave power/temperature relationship required for the accurate control of materials processing.

Dielectric properties are determined using the cavity perturbation method and the resonant parameters are measured using an HP 8720ET Network Analyser. The equipment uses high power single mode microwave heating in conjunction with the measurement of dielectric parameters quasi-simultaneously. In addition to controlling the heating and measuring modes, the computer also controls the Network Analyser, temperature sensor and the sequencing of heating/measuring mode.

We show that physical and chemical changes in materials such as solid-solid phase changes, decomposition, melting etc. under microwave heating can be identified from the sample's permittivity-temperature profile. The dielectric constant-temperature profiles for SiC, $KNO_3$ and AgI showed that the dielectric constant of SiC remains essentially constant over the temperature range used while those of AgI and $KNO_3$ show considerable changes at their corresponding solid-solid phase change temperatures. We demonstrate that MDTA supplements existing conventional calorimetric techniques by providing dielectric information on materials heated in a microwave field. The technique is shown to be an efficient tool for distinguishing physical processes such as reversible or irreversible phase changes, decomposition, melting etc. Furthermore, even chemical reactions can be monitored via permittivity-temperature profiles. We demonstrate the potential to adopt the technique for online permittivity measurement in industrial applications for monitoring chemical processes rather than time consuming ex-situ sample analysis.

## REFERENCES

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