

Method and Automatic System for Non-Destructive Determination of Physical - Chemical Properties of Powdered Materials

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The present paper relates to non-destructive electromagnetic testing method for determination of physical - chemical properties of powdered materials, especially as related to quality control of powdered materials used in battery manufacturing.

The non-destructive method allows rapid analysis of electromagnetic properties and chemical composition of the powdered materials based on CFx and also provides information regarding chemical kinetics of the reactions taking place during material synthesis.

The electromagnetic analysis system can replace normally used wet chemical methods of analysis and/or instrumental methods, such as XRD, XPS, XES and FTR for the determination of carbon/fluorine ratios in CFx (polycarbon monofluoride) samples.

Principle of measurements of fluorine content in graphite powder is based on existing dependence between fluorine content in fluorinated graphite powder (CFx) and dielectric permeability of the powder.

As a sensitive element in the invention, a caplanar capacitor is used. The electrodes of the capacitor are of coaxial ring form (Fig.1) and are located in one surface level of the CFx powder. As the initial informative parameters the Q-factor and capacitance of the sensor were used.

A linear relationship between electromagnetic properties and the composition of the material has been established (Fig.2) to determine chemical composition of CFx in the range of $x=0.25$ to 1.2 as well as provide information on the kinetics of the F_2 and carbon reaction over a wide range of temperatures.

Along with the application of CFx for Li-ion batteries the CFx material also supplied for non-battery applications with lubrication additives being the major growth area. Other applications include additives in dry inks, additives in elastomeric seals, oxidation resistant catalyst supports and chromatographic column packing.

The results of the non-destructive evaluation of the level of uniform distribution of the CFx degree of fluorination on the pallet (Fig. 3) can be used for optimization of the parameters of fluorination.



Fig. 1 General view of the electromagnetic non-destructive measuring unit and remote measuring transducer for determining level of CFx fluorination

Electromagnetic parameters - average

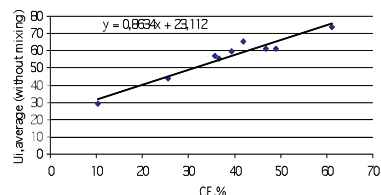
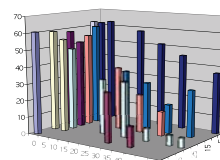
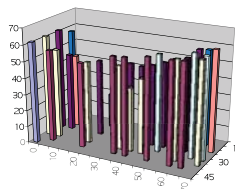


Fig. 2 The calibration curve for electromagnetic non-destructive determining level of CFx fluorination has a linear character (nature) with a high level of correlation



a



b

Fig. 3 Three-dimension graph of fluorine-concentration distribution in powder along co-ordinates in the plane of pallet on the initial (a) final (b) stage of the fluorination measured by non-destructive electromagnetic method