A DIGITAL CORRELATOR FOR USE IN INTENSITY FLUCTUATION SPECTROSCOPY

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ABSTRACT

A digital correlator suitable for applications in intensity fluctuation spectroscopy is described. Intensity fluctuation spectroscopy is a technique in which temporal fluctuations in the intensity of scattered laser light are analysed in order to obtain information about the motion of the scatterers. However a drawback of intensity fluctuation spectroscopy is that even very small amounts of contaminant dust can make the measured data difficult, if not impossible, to interpret.

To help overcome this problem a device, known as the "blinker", is incorporated in the correlator. This device enables light scattering measurements to be made on less than scrupulously clean samples by monitoring the scattered light intensity and inhibiting data collection whenever the presence of dust in the scattering sample is suspected.

An outline of intensity fluctuation spectroscopy is given followed by a review of correlation techniques with particular emphasis on photocount correlation, and on methods of reducing the complexity of the correlator circuits. The reasons for adopting the single clipping technique are noted, and the specification and design of the instrument discussed. The electronic circuits and their operation are described.

The instrument has several different modes of operation. These include: single-clipped, double-clipped, or scaled and clipped autocorrelation; cross-correlation; probability density and distribution analysis; and multichannel signal averaging.

The effect of dust on the measured intensity correlation function is examined and techniques which have been developed to minimise this effect are reviewed. The blinker technique is described in detail together with a description of the required electronic circuits.

The procedure for testing the correlator is given. Since much of the

testing was performed on the complete intensity fluctuation system, this system is described and details given of the sample preparation and correlation data analysis techniques. Results are presented to demonstrate the correct operation of the instrument.

Experimental results are also presented to show how the blinker was used to minimise the effect of dust contamination in a dilute solution of 91nm diameter polystyrene latex spheres. Examples are included of the application of the blinker in the study of concentrated latex sphere solutions, and in the study of dilute and concentrated solutions of polystyrene random coils.

Finally, some proposals are made for future developments which include a software correlator and a hardware full correlator, both of which are based on the existing instrument.

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