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Note

Application of interferometry in studies of transport processes near ionites and adsorbents

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The properties and dynamics of ionites and neutral adsorbents are usually studied by means of chromatography. However, it should be possible to obtain useful information from interferometric observations of concentration gradients in the solution near a single grain or a thin layer of adsorbent. To the best of our knowledge, such investigations have not yet been performed.

Even at relatively low solution concentrations, gradient profiles can clearly be seen on interferograms. The interference fringe shift is a measure of optical density changes[1] and, indirectly, of solution concentration changes. The direction of the fringe deflection indicates the direction of species transport in a diffusion layer, and the area between the concentration distribution curve and the line of initial concentration indicates the quantity of the adsorbed substance.

RESULTS

The observations were carried out with a double beam laser interferometer of the Jamin type[2]. A comparison of Fig. 1b and c illustrates the changes in profiles at various concentrations of potassium chloride in solution. Fig. 1d shows the reversed shift upon regeneration by hydrochloric acid of the ionite. The effect of the duration of adsorption of Cu^{2+} and saccharose is illustrated in Figs. 2 and 3. The gradients observed in a saccharose solution near silica gel (Fig. 3) seem to indicate an equalization of the concentrations in the solutions inside and outside the adsorbent.

Analogous results were obtained in the case of anion exchangers or extractants, *e.g.*, for a toluene drop hanging at the end of a thin glass stick in water–acetone solution.

The interferograms also show that the kind and state of the adsorbent can easily be determined using a single grain or a small piece of silica gel plastic folie and an appropriate solution. The magnitude of the fringe shift and the duration of the gradient provide additional data about the ionite capacity and the adsorption rate which can be the source of information about dependence of adsorption on grain thickness and rate of liquid flow.

Mathematical calculations of the transport processes occurring in the solution outside and inside a grain are complex as the concentration on the ionite surface increases with time, and inside the grain a shifting zone of full occupancy by ions in

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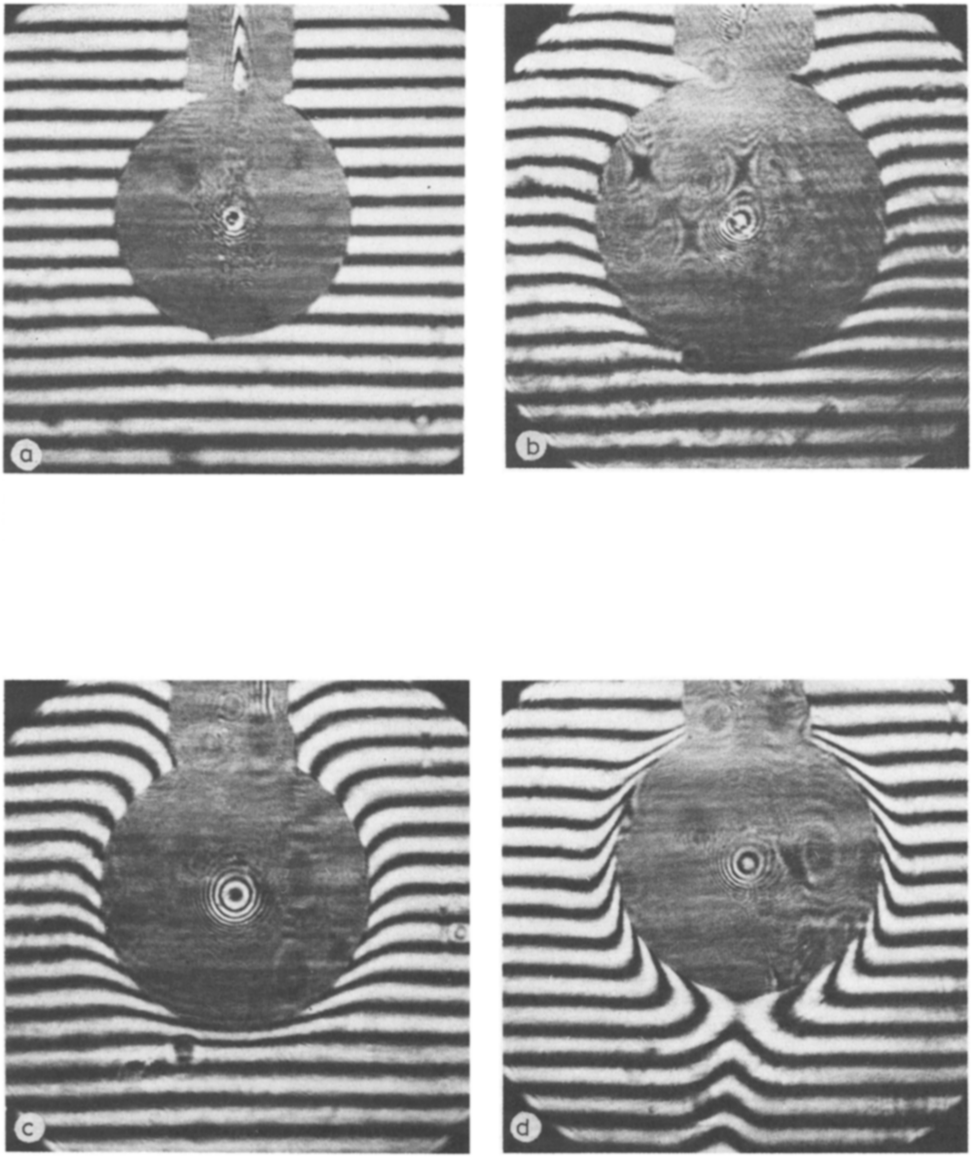

Fig. 1. Interferograms of aqueous solution near a cation exchanger grain of Zerolit 225X8 (diameter, 0.37 mm, capacity *ca.* 3.5 equiv./dm^3). Photographs were taken 30 sec after ionite immersion in water (a), 0.1 *M* KCl (b), 1 *M* KCl (c), 2 *M* HCl, the exchanger occupied by Cu^{2+} (d).

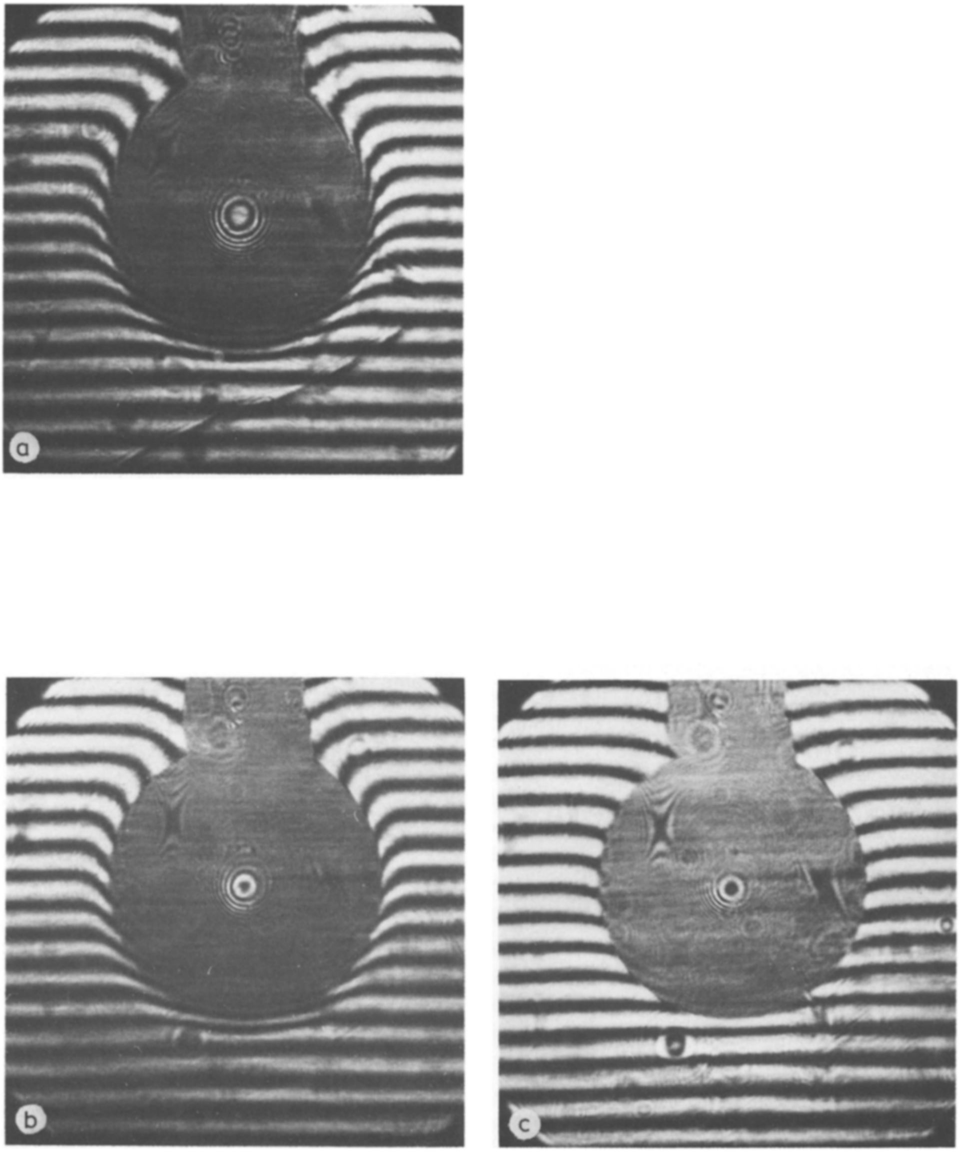

Fig. 2. Interferograms of 0.05 *M* copper sulphate aqueous solution near a cation exchanger grain of Zerolit 225X8 after 15 (a), 120 (b) and 900 sec (c).

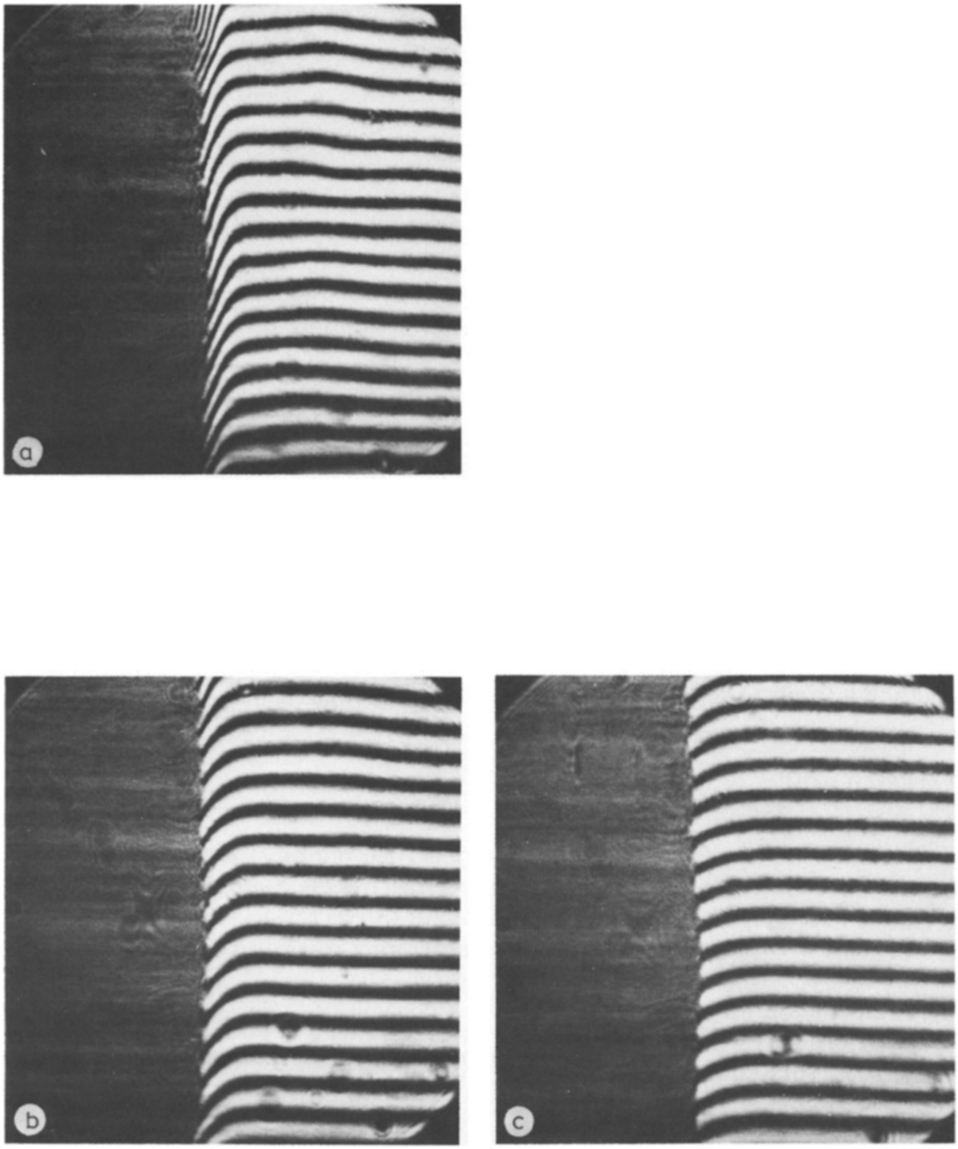

Fig. 3. Interferograms of 5% saccharose aqueous solution near a 0.2-mm layer of silica gel (DC-Plastickfolien Kieselgel 60, Merck) after 10 (a), 60 (b) and 180 sec (c).

ionite as well as an equalization of the concentrations in the solution around the grain and inside the pores takes place.

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