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A NOVEL TYPE OF POLYMERIC METAL OXYSTEARATES LANGMUIR-BLODGETT FILMS

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Langmuir monolayers of polymeric titanium oxystearate have been fabricated by hydrolysis and polycondensation reaction of titanium alkoxystearates at air-water interface. Titanium alkoxystearates were produced by substitution at three different tetrabutoxytitanium/stearic acid ratios in chloroform. Corresponding to each case the compression isotherms of reaction products were obtained. Preliminary STM investigations were carried out.

INTRODUCTION

Recently the great interest on LB films containing inorganic nanoparticles has been noticed because of their potential applications in molecular electronics and in single electronic devices particularly. In a previous paper we reported on the single-electron transistor based on a single cluster molecule operating at the room temperature [1]. Reliable fixing of clusters in single-electron devices was achieved by incorporation of carborane clusters into a Langmuir monolayer matrix [1,2]. We presume that clusters will be fixed more reliably if they are bound chemically inside LB film. Inorganic polymer LB films have higher melting temperature in comparison with non-polymeric films. They are, therefore, good candidates for applications in microelectronics. In this paper we describe preliminary investigations on synthesis and monolayers of polymeric titanium oxystearate.

EXPERIMENTAL METHODS

Solutions of tetrabutoxytitanium (TBOT, 0.0006 M) and stearic acid (0.001 M) were mixed at molar ratios of 1:1.7, 1:2, 1:3 to form alkoxystearates before spreading onto MilliQ water subphase. The stearic acid was purchased from Serva (more than 99% purity). TBOT was purchased from IREA (Russia, 99,5% purity). A fully computerised rectangular Teflon trough designed by the authors at the Biophysics Department (Physics Faculty) in Moscow State University was used. Surfactant solution was rest at the water surface up to 10 minutes for hydrolysis. Monolayer was compressed by a mobile Teflon barrier at a speed of 10 A^2 $molecule^{-1}$ min^{-1} for film balance investigation and for deposition. Inorganic polymer monolayers were transferred onto pyrolytic graphite substrate for STM study. STM images were obtained in air using Nanoscope I STM at room temperature (tunnelling current of 0.5 mA, bias voltage of 500 mV).

The properties of the LB-films should be influenced by TBOT\stearic acid ratio. When the ratio is of 1:1.7, the formation of titanium alkoxystearates with one and two stearic groups is possible after replacement of butoxy-groups by stearic ones. The rest of $-O-C_4H_9$ -groups must be replaced by OH -groups after hydrolysis. This phenomenon can result in two- and three- dimensional structures during polycondensation. It would lead to formation of titania