The Aggregates in LB Films of Schiff base Aluminium (III) Complex

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Abstract: The surface pressure-area (π-A) isotherm of Schiff base aluminium (III), tris (2-hydroxy-5-nitro-N-dodecyl-benzylideneaminato) aluminium (III) (denoted as $Al(TA12)_3$), on pure water subphase was investigated. The molecular area, 0.48 nm^2, is one-third of expected value that indicated the aggregation took place. The Langmuir-Blodgett (LB) films of $Al(TA12)_3$ was transferred and characterized. The AFM image confirmed the formation of aggregates.

Keywords: Aluminium (III)-Schiff base complex, LB films, aggregate, AFM image.

Metal complexes, which are composed of metal ions and amphiphile ligands, show some structural peculiarities in Langmuir-Blodgett (LB) films. In the past studies, the metal complexes were mainly composed of the transitional metal ions[1,2]. The metal ions in IA, IIA and IIIA were seldom mentioned. Further more, the aluminium element is at the position where the typical metal elements transit to the typical non-metal elements in the periodic table of elements and study on the properties of Al^{3+} complexes LB films is not so much[3]. In this work, we investigated the monolayer behavior and LB films characteristics of this complex.

Figure 1 is the surface pressure-area isotherm of $Al(TA12)_3$. It illustrates that the metal complex can form stable Langmuir film on the water surface. But in lower pressure region below 15 mN/m, the collapse area, 0.48 nm^2, is much smaller than we expect. It is known that the headgroup consisting of the phenyl ring and the chelating ring is about 0.5nm^2 and the collapse area of a similar metal complex $Cu(SA16)_2$ is 0.9 nm^2[2, 4]. There are three headgroups in $Al(TA12)_3$ and its area should be about 1.5 nm^2. The collapse area should have nothing with the length of the hydrophobic chains. One reason may be that the radii of Al^{3+} (0.5Å) is much smaller than that of Cu^{2+} (0.72Å) and the other is that the plane of each headgroup can not oriented in a same plane parallal to the water surface and the planes should aggregate . If the headgroups are in the same plane, it will be more crowded and the chelating atoms can not be form stable bond with Al^{3+}. So the plane of each headgroup is supposed to be oriented with an angle to the subphase surface. In the region of surface pressure from 15 mN/m to 18 mN/m, the non-horizontal plateau indicates a collapse process. And in the higher surface pressure region, an area of 0.2 nm^2 was observed that indicates non-order aggregates.

The AFM images of LB films of $Al(TA12)_3$ are displayed in **Figure 2**. In **Figure 2a**, the LB film was transferred in 20 mN/m and the image shows many non-order aggregates. While in **Figure 2b,** when the LB film was transferred in 10 mN/m, a piece aggregate structure was observed. In that the size of parallel with the barrier is very long and of vertical with the barrier is about 0.2 μm.

Figure 1 Surface pressure-area isotherm of $Al(TA12)_3$ on pure water

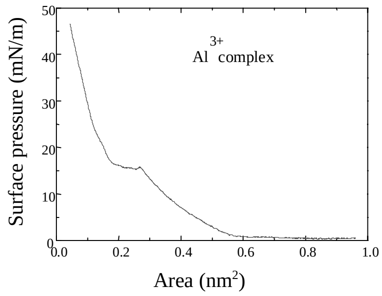
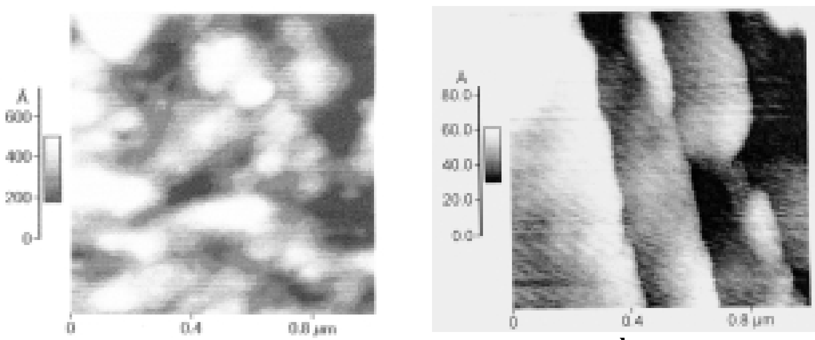


Figure 2 The AFM image of the metal complex



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