酸によって生ずる DOPH ミリポア膜の自励発振

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Electric Self-sustained Oscillations of a DOPH-Millipore Membrane induced by Acids

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A DOPH-Millipore membrane shows electric self-sustained oscillations with periods of a few seconds under salt-concentration gradient, electric current and pressure difference. We have found that the oscillations with periods of a few seconds are induced by the addition of acid without the electric current and the pressure difference.

Key words : DOPH-Millipore membrane, self-sustained oscillation.

A DOPH-Millipore membrane is composed of a Millipore filter infiltrated with a synthesized lipid, dioleoyl phosphate (DOPH). This membrane shows an appreciable variation of electric capacitance, electric resistance or membrane potential near the critical salt concentration of 30 mM^{1, 2)}. This phenomenon is attributed to a phase transition of DOPH molecules between oil droplets at the lower concentration and micelles or multilayer leaflets at the higher concentration²⁾. When this membrane is placed between two cells filled with salt solutions of the lower and the higher concentrations, electric self-sustained oscillations are observed with rather long periods of several minutes or a few hours. These oscillations are attributed to a nonlinear coupling of the phase transition of DOPH molecules with salt flow. When the salt flow is accelerated under electric current and pressure

difference, the oscillations are observed with shorter periods of a few seconds^{3~7)}. We have found that electric self-sustained oscillations with periods of a few second occur without the electric current and the pressure difference when an acid is added into the salt solution of the lower concentration.

DOPH was synthesized by hydrolysis of the reaction product of oleyl alcohol and phosphorus oxychloride. Millipore filters (cellulose ester) of a pore size of 5 μ m were immersed in a benzene solution of DOPH and then dried. The adsorbed amount of DOPH was about 4 mg/cm². The membranes obtained were placed between two cells with holes of 1 cm in diameter. One cell was filled with 100 mM KCl solution and the other was filled with 5 mM KCl solution. An acid was added into the 5 mM solution. (When added into the 100 mM solution, the oscillations as mentioned below were not ob-

Fig. 1 Changes of membrane potential and membrane resistance of a DOPH-Millipore membrane caused by the addition of HCl.

served.) Membrane potential was measured with a pair of Ag-AgCl electrodes through a high impedance ($>10^{10} \Omega$) amplifier. The electrode in the 5 mM solution was connected with a ground. Membrane resistance was measured by suppling a constant current of 1 nA with the other pair of Ag-AgCl electrodes. Without the addition of acid, membrane potential was about -60 mV and membrane resistance was about $3.5 \text{ M}\Omega$.

Figure 1 shows the changes of membrane potential and membrane resistance by the addition of HCl. After the polarity was reversed at the HCl concentration of 10^{-3} M , membrane potential varied as shown in Fig. 1. Membrane resistance did not much vary and it was over $1 \text{ M}\Omega$ even at the HCl concentration of 1 M .

Electric self-sustained oscillations occurred at the HCl concentrations over 0.05 M . Figure 2 shows typical examples of the oscillations. At the HCl concentration of 0.05 M , an oscillation was observed with amplitudes of about 3 to 20 mV and a period of several seconds. The peaks of the oscillation were toward zero of membrane potential. With increasing the concentration of HCl, the period of the oscillation became shorter and more chaotic. In this case, the oscillation at each concentration was observed for 15 minutes. Therefore, the oscil-

Fig. 2 Electric self-sustained oscillations of a DOPH-Millipore membrane induced by the addition of HCl. (a) 0.05 M , (b) 0.1 M , (c) 0.5 M , (d) 1 M .

lations continued for over 60 minutes as a whole. Similar oscillations also occurred at the concentrations over 0.05 M of H_2SO_4 .

The mechanism of the effect of acid on the oscillations mentioned above is not clear. We tentatively suppose that the flow of K^+ through the membranes is accelerated by the opposite flow of H^+ and the period of the cyclic phase transition of DOPH molecules become shorter.

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＜学会だより＞

第23回無機高分子研究会講座

主題＝無機高分子を用いたセラミックスのマイクロ複合化

＜趣旨＞ ファインセラミックス材料が脚光を浴びて久しいが、材料として先端分野へのより一層の展開をはかるためには、複合化による高性能化が重要な課題である。特に、複合構造の精密制御法の開発が急務である。ゾル-ゲル法やブリカーサセラミックスを用いた方法などの、いわゆる無機高分子を利用したセラミックス合成法は、セラミックスのマイクロ複合化を達成するための有力な手法として注目を集めている。本講座では、無機高分子を用いたセラミックス合成法の基礎と応用について第一線の研究者の方々に講演をお願いした。

主 催：高分子学会 無機高分子研究会

(三井鉱山) 宇都宮泰造

日 時：平成2年9月13日(木) 10:00～16:10

参加要領：1) 定 員 100名

会 場：国立教育会館 602会議室(東京都千代田区霞ヶ
関3 ☎ 03-580-1251)

講 演：1) セラミックス前駆体としての無機高分子の
合成と利用

(東京理科大学理学部) 阿部芳首

2) 制御されたコロイド溶液を前駆体とする機
能性セラミックスの製造

(コロイドリサーチ) 関根正裕

3) 有機金属重合体を用いた繊維強化セラミッ
ク複合材料

(ノリタケカンパニーリミテッド) 岩田美佐男

4) ゾル-ゲル法によるマイカガラスセラミック
スの製造と特性評価

2) 参加費 会員(含協賛学協会会員) 会社
10,300円, 大学・官公庁 4,120円, 学生 1,030
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