

Vynylon Prepared in Spring Water and Vynylon/Polyethylenedioxythiophene Composite



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ABSTRACT

In this research, we prepared vynylon synthesized in spring water from Zao. Furthermore, vynylon/poly(3,4-ethylenedioxythiophene) (PEDOT) composite was prepared with vynylon synthesized in spring water. The compounds thus synthesized in this study were evaluated with infrared absorption (IR) spectroscopy measurements and scanning electron microscopy (SEM) observations.

Keywords: Composite, conductive polymer, spring water.

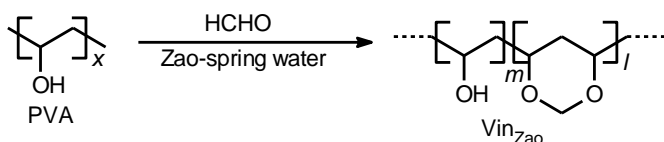
Introduction

Hot spring water contains many kinds of minerals like Ca, Mg, Al, and ions such as SO_4^{2-} , Cl^- , and HSO_4^- [1]. pH of the hot spring water depends on place and time [2].

In this research, vynylon was synthesized in the spring water obtained from Zao, Japan. Spring water was used as both acid catalyst and solvent during the reaction. Furthermore, vynylon/poly(3,4-ethylenedioxythiophene) (PEDOT, a conducting polymer) composite was synthesized with vynylon thus prepared in this study.

Experimental

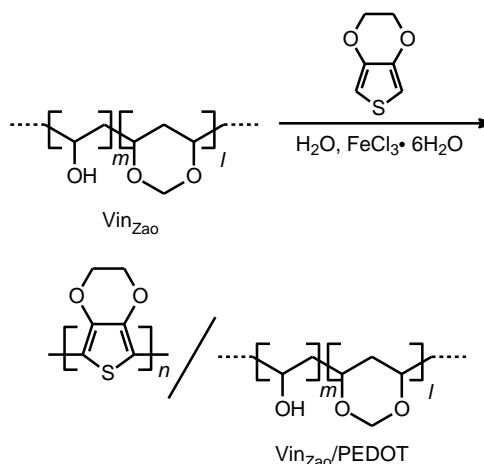
Synthesis



Scheme 1. Synthesis of Vin_{Zao} (vynylon) in the presence of Zao-spring water. PVA: polyvinylalcohol.

First, vynylon was synthesized in Zao-spring water (pH = 2.0, 60 mL) from polyvinylalcohol (PVA,

2.0 g) with a small volume of formaldehyde (Scheme 1). Vynylon was first synthesized by Sakurada in 1939. Polyvinylalcohol was formalized with H_2SO_4 , Na_2SO_4 , HCHO and H_2O in the study. H_2SO_4 was used as an acid catalyst. Na_2SO_4 was used to prevent softening of fiber by formalization. H_2O was employed as a solvent [3]. Therefore, the acid component of the Zao-spring water played a role of acid catalyst and a solvent.



Scheme 2. Synthesis of Vin_{Zao} /PEDOT. PEDOT: poly(3,4-ethylenedioxythiophene).

This polymer (vinyon) is abbreviated as Vin_{Zao} . Then, Vin_{Zao} thus prepared (0.02 g) and 3,4-ethylenedioxythiophene (EDOT, 0.2 g) were added into the distilled water (1 mL) and stirred. After two days, $\text{FeCl}_3 \cdot 6\text{H}_2\text{O}$ (0.2 g) was added into the mixture over night (Scheme 2). The precipitate was collected by filtration and the solvent was removed under vacuum to afford a black solid.

Results and discussion

Molecular Structure

Figure 1 shows infrared absorption (IR) spectra for EDOT (monomer), Vin_{Zao} and $\text{Vin}_{\text{Zao}}/\text{PEDOT}$ composite. EDOT exhibited bending vibration of C–H in aromatic ring with α carbon at 890 cm^{-1} . While, $\text{Vin}_{\text{Zao}}/\text{PEDOT}$ showed no signal derived from the monomer at 890 cm^{-1} . $\text{Vin}_{\text{Zao}}/\text{PEDOT}$ shows C=O and C=C stretching vibration at 1697 and 1539 cm^{-1} due to the vinyon structure, respectively. The signal at 1150 cm^{-1} and 1165 cm^{-1} is derived from the C–O–C stretching vibration of vinyon in Vin_{Zao} and $\text{Vin}_{\text{Zao}}/\text{PEDOT}$, respectively. These results confirm that the synthesis of Vin_{Zao} and $\text{Vin}_{\text{Zao}}/\text{PEDOT}$ was achieved.

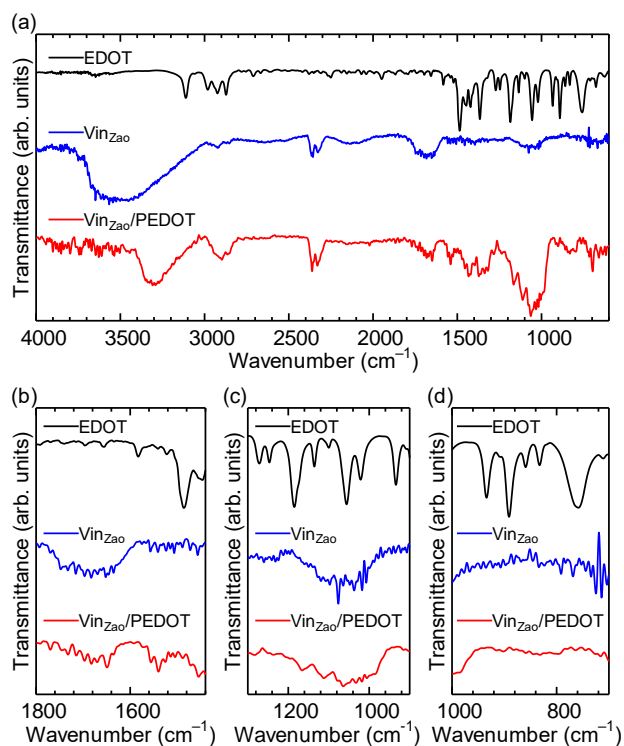


Figure 1. Infrared absorption spectra for 3,4-ethylenedioxythiophene (EDOT, monomer), Vin_{Zao} and $\text{Vin}_{\text{Zao}}/\text{PEDOT}$. (a): full scale. (b): $1800 - 1440\text{ cm}^{-1}$. (c): $1300 - 900\text{ cm}^{-1}$. (d): $1000 - 700\text{ cm}^{-1}$. Vin_{Zao} : vinyon prepared in Zao-spring water.

Surface images

Figures 2,3 show SEM images of non-Au coated Vin_{Zao} and $\text{Vin}_{\text{Zao}}/\text{PEDOT}$, respectively. Vin_{Zao} has roughness structure (Figure 2a,b). While, $\text{Vin}_{\text{Zao}}/\text{PEDOT}$ displays less roughness (Figure 3a). Magnification image of $\text{Vin}_{\text{Zao}}/\text{PEDOT}$ evaluated that $\text{Vin}_{\text{Zao}}/\text{PEDOT}$ has porous structure on the surface (Figure 3b,c).

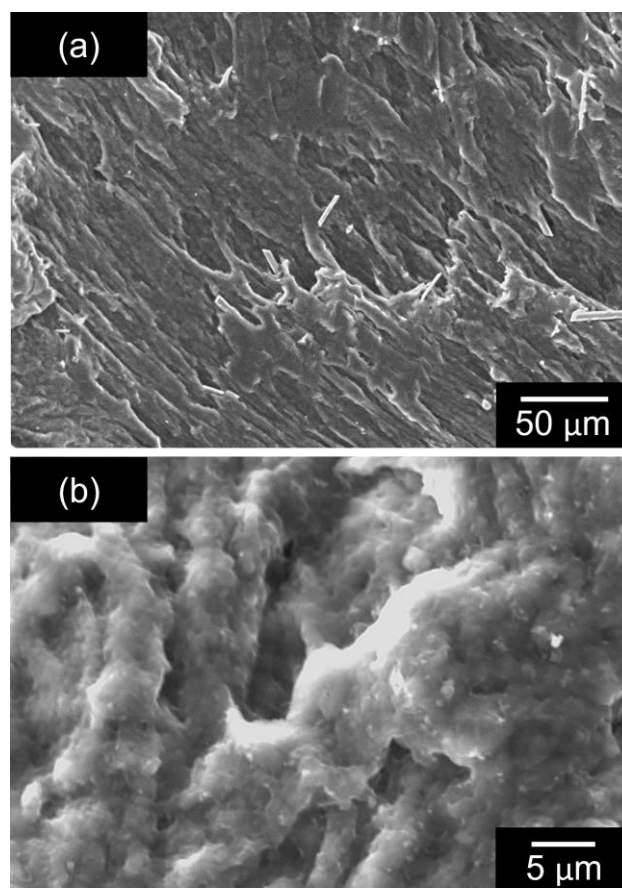


Figure 2. Scanning electron microscopy (SEM) images of Vin_{Zao} . (a): Low magnification. (b): High magnification.

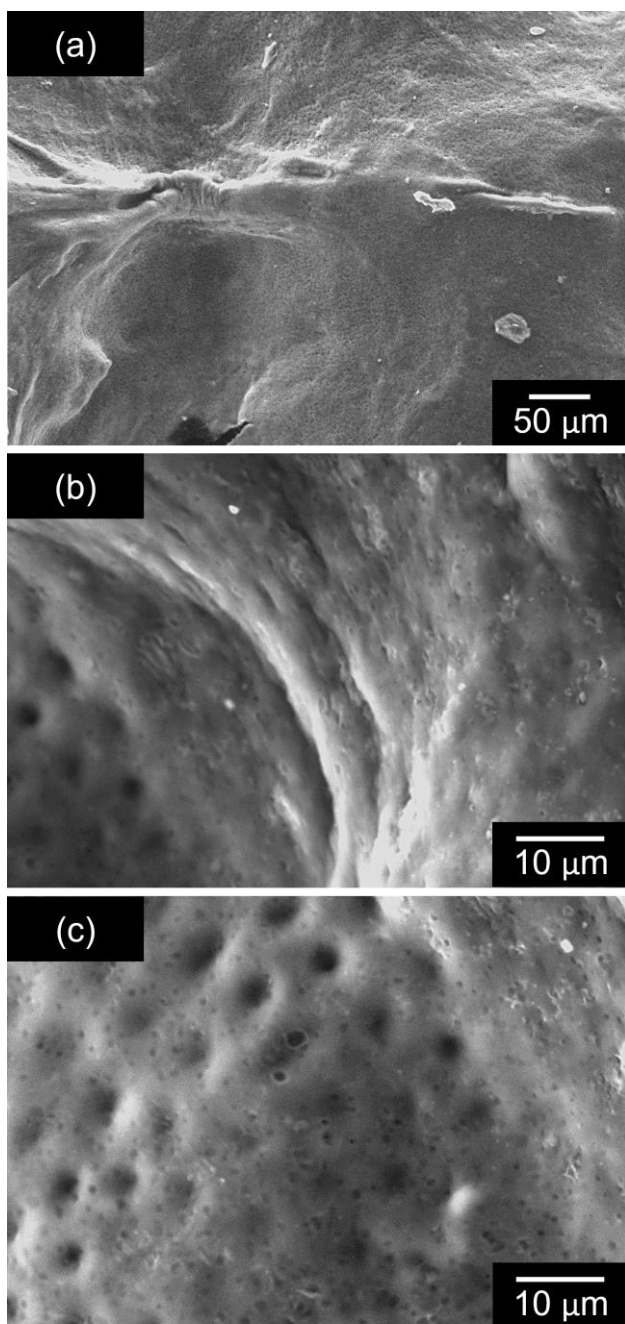


Figure 3. SEM images of $\text{Vin}_{\text{Zao}}/\text{PEDOT}$. (a): Low magnification. (b,c): High magnification.

Conclusions

Preparation of vinylon synthesized in Zao-spring water, and composite formation of the vinylon with PEDOT were successfully achieved. PEDOT as a conducting polymer was coated the entire surface of the vinylon.

Acknowledgements

The volcanic spring water for reaction solvent was kindly gifted by Zao Onsen Tourism Association. The authors would like to thank Glass Workshop of Central Workshop of University of Tsukuba for fine glass works.

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Received: 28 January, 2021

Accepted: 2 February 4, 2021



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