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**Inorganic production of membranes
together with iron carbide via
oxidation of iron in the water that
includes carbon dioxide plentifully**

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Topics

[Experiments]

- 1) Electrolysis in which carbon electrodes is used.
- 2) Deoxygenation of carbonated water by oxidation of metal atom.

[Analyses]

- 1) Infrared spectrometry
- 2) Energy dispersive X-ray spectroscopy.
- 3) Pack test of chemical oxygen demand (COD).

[Discussion]

- 1) Behavior of carbon atom in water
- 2) Ecosystem of atoms
- 3) Chemical evolution

What materials were investigated?

Those were appeared in saline carbonated water with steel wool.

After about 24 hours from addition of steel wool , floating materials appear on the surface of a saline carbonated water that is provided by adding NaCl and dry ice (CO₂).



[Steel wool]



[Right after addition]



H₂O, CO₂ ,NaCl ,Fe

[After 24 hours from addition]

- The oxygen atoms were removed to the bottom as compound of Fe₂O₃·nH₂O, and a membrane appeared in the surface of the liquid.

Is the reaction between iron and carbon possible by electrolysis processing?

The reaction takes place by electrolysis.



[Fe in H₂O]



[Right after]



[10 hours later]

Floating material includes small bubbles. The bubble is the evidence that the molecule possesses with polarity.

Why membrane were formed from Fe and CO₂ at the glass wall of silica?

Membrane of iron carbide were produced from iron and CO₂ at glass wall of silica .

[Reaction of iron powder with CO₂ by the soda glass wall that is silica (SiO₂) functions as a catalyst]



[The carbonated water that contains iron synthesize similar membrane in a soda glass of bottle]



Iron atoms (Fe) are arranged at surface of glass wall where oxygen atoms are arranged, And the iron atoms (Fe) are connected with oxygen atoms of CO₂.

Materials for analyses

24hours after added steel wool of (Fe) in carbonated water (H₂O + CO₂), membrane was formed. It is formed by molecules possessed with polarity such as Fe₃C.



[Carbonated water]
(impurity Na=13ppm)

Hydrophobic materials on the surface



Thin membrane on the glass wall



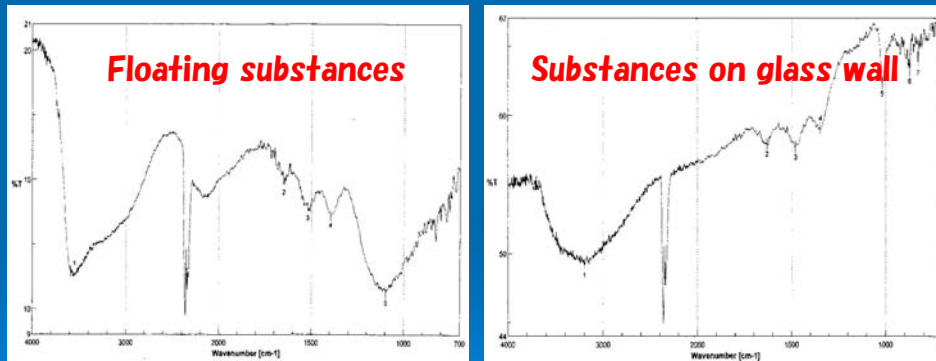
栄養成分 100mlあたり	
エネルギー	0 kcal
たんぱく質	0 g
脂質	0 g
炭水化物	0 g
ナトリウム	1.3 mg
糖	0 g

Corrects error in resume

appear on the surface of saline water in which CO₂ was solved with high density.

What type of chemical bond exists in the membrane?

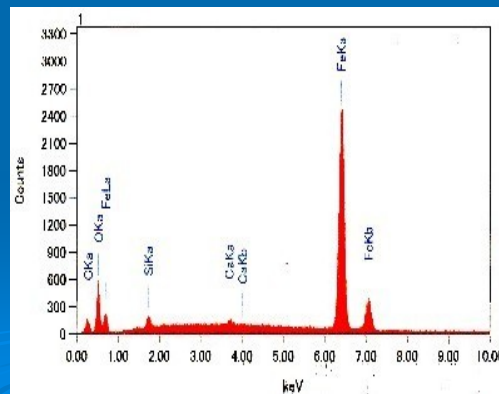
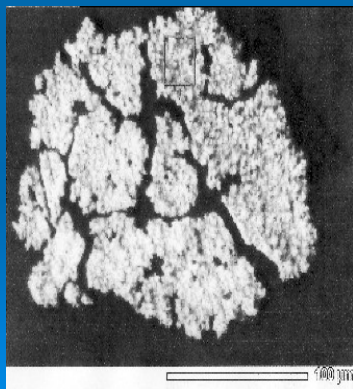
Fourier Transform Infrared Spectroscopy (FT-IR)



Molecular bonds vibrate depending on the type of bonds. Then, the infrared spectroscopy is a tool to identify chemical bond.

Spectrum of x-ray energy is measured to determine the atomic constituents.

Elementary analysis by energy dispersive X-ray spectroscopy (EDS)



What kinds of molecules are formed?

φ(ρz)法 簡易定量分析				
フィッティング係数: 0.2972				
元素	(keV)	質量%	誤差%	原子数%
C K	0.277	3.14	0.11	11.70
O K	0.525	4.94	0.10	13.83
Si K	1.739	0.77	0.13	1.23
Ca K	3.690	0.47	0.17	0.53
Fe K	6.398	90.68	0.48	72.71
合計		100.00		100.00

The iron atom in steel wool is dissolved in the carbonated water. And the iron atom forms floating materials.

φ(ρz)法 簡易定量分析				
フィッティング係数: 0.2890				
元素	(keV)	質量%	誤差%	原子数%
C K	0.277	3.75	0.10	12.61
O K	0.525	9.30	0.09	23.46
Si K	1.739	1.33	0.13	1.91
Ca K	3.690	0.61	0.17	0.62
Fe K	6.398	85.00	0.46	61.41
合計		100.00		100.00

The material is a compound. Capable compounds are iron carbide (Fe_3C), iron oxide (Fe_2O_3), carbon dioxide (CO_2), and water (H_2O).

φ(ρz)法 簡易定量分析				
フィッティング係数: 0.2784				
元素	(keV)	質量%	誤差%	原子数%
C K	0.277	7.19	0.09	22.01
O K	0.525	9.74	0.09	22.38
Si K	1.739	1.23	0.11	1.61
Ca K	3.690	0.52	0.16	0.48
Fe K	6.398	81.32	0.43	53.52
合計		100.00		100.00

There are some contamination. But main constituent of the floating material is iron (Fe). More than 50% of constituents is iron (Fe). It is considered that the floating material includes iron carbide (Fe_3C).

The iron carbide is intermediate chemicals. The ratio among Fe atoms and C atoms is not fixed. But each molecule is possible to possess an electric polarity.

Chemical Oxygen Demand (COD) increases when dry ice of CO_2 was added in water with iron

[H_2O]

(Tap water) [$\text{H}_2\text{O}+\text{CO}_2$] [$\text{H}_2\text{O}+\text{Fe}$] [$\text{H}_2\text{O}+\text{Fe}+\text{CO}_2(\text{dry ice})$]



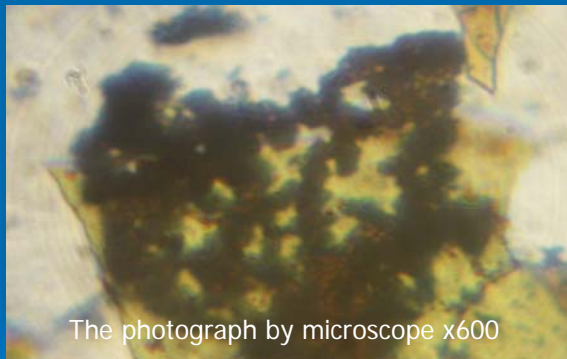
After 10 hours

[$\text{H}_2\text{O}+\text{Fe}+\text{CO}_2(\text{dry ice})$]



Pack test of Chemical Oxygen Demand (COD) depends on the reaction of KMnO_4 (Potassium permanganate)

There are two kind of materials on the surface of water



The photograph by microscope x600

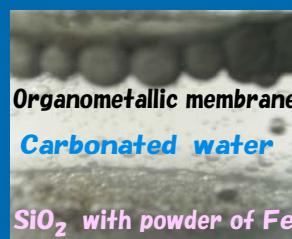
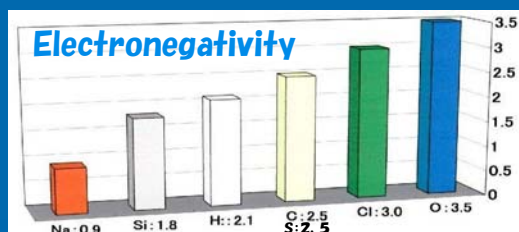
The iron carbide (Fe_3C) has been investigated to assist Fischer-Tropsch (FT) reactions for synthesizing hydrocarbon.

Reaction to synthesize hydrocarbon



Ecosystem of atoms in which each state of atom is adapted to its environment

An atom occupies electronic state that fits to its circumstance among possible states. Carbon atom possesses adaptability to environment.



- 1) Fe atom is oxidized by O atom of CO_2 in water.
- 2) Free C atom connects to Fe atom and iron carbide is made.
- 3) Iron carbide form a bubble in water. The inside of bubble is carbon atom.
- 4) Inside of the carbon atom has a tendency to accumulate proton more than iron.
- 5) Oxidation of iron carbide in the water produces iron oxides and free carbons and protons. $2\text{Fe}_3\text{C} + 9\text{H}_2\text{O} \rightarrow 3\text{Fe}_2\text{O}_3 + [2\text{C} + 18(\text{H}^+)]$

What is the mechanism that organizes reactions for a first life?

Continuing reactions of a life were organized in the membrane of bubble that is made of Fe_3C

1. Free H^+ (proton) is sent from the sun. It is also provided by oxidation of metal atom in the membrane.
2. H^+ provides energy of organic reaction. Because, H^+ is able to excite the other atom by receiving an electron.
3. Density of H^+ brings potential difference. It results in flow of H^+ . The flow of H^+ is able to transfer the other ion. H^+ is available as driving force for activities of primitive life.

What is the life? The life is a chain of reactions with a body.

The chain of reaction is described as
If, then. If, then. If, then ...the end.

Change of reaction results in a trial and error.

[Chemical evolution in an ecosystem]

[Activity on organic molecules] | [Organized activity]

Reaction → Chain → Circulation → Self reproduction

The existence of activity is survival. As the result, each creature organizes activities.

Conclusions

- Iron carbide was produced via oxidation of iron atom in carbonated water.
- The organometallic molecule of iron carbide forms a membrane and bubbles in carbonated water. Inside of the bubble, the carbon atom in the membrane has tendency to accumulate proton more than iron atom. It is possible to explain outline of the scenario that primitive life was born.
- The chemical evolution depends on protons and the ecosystem in which each atom fits its possible electronic state to the circumstance.