





# 제13회 국제학술심포지엄 (2022.07.21. 온라인)

## The Future of Food: Strategies for Food Security

### How much quantity and quality of crop production can we improve? Application in Oxide-Graphene Sensor and Aeroponics

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**INTRODUCTION**

As the population increases rapidly and the climate crisis has been accelerating, it is essential to find a way for mass production. Traditional cultivation method and turning to the drain water into the soil, there is less water absorbed by the roots compared to the amount of water supplied. In addition, if the pH decreases due to the acidification of the soil, crop is likely to be deficient, reducing production efficiency and quantity of crops. Aeroponics can help these problems effectively using soil recycling water.

**CHARACTERISTICS AND PRINCIPLE OF AEROPONICS**

**What is aeroponics?**

Aeroponics is the way of growing plants that don't use soil. Instead, we use a solution with nutrients to grow the crop. By Aeroponics we could grow anything in theory. However, to grow any crops, we should provide them with essential nutrients to their roots. Generally, we grow atmospheric, terrestrial, and aquatic, etc.

The aeroponic system is growing the production through soil farming. However, most studies showed that potato production increased 40% to 50%, and the tuber's weight has decreased by 50%. This is because the aeroponic systems are influenced by the environmental such as oxygen, temperature, and photoperiod.

**ADVANTAGES AND PRINCIPLE OF AEROPONICS**

1. Improve the yield of short-lived crops, vegetables, etc.
2. Lower cost than hydroponic nutrient solution (recycling bottle water)
3. High water efficiency (up to 90% improvement in water consumption)
4. Can be automated automatically so it is possible to expand the scale by mechanization
5. Able to develop new technology
6. The working environment is better because it is not contaminated by insects
7. Weather does not influence the yield

**DISADVANTAGES**

Initial cost is very high  
→ cost needs to be reduced for commercialization through technical research

**HOW DOES OXIDE-GRAPHENE SENSOR DETECT THE DEFICIENCY RESPONDING PRINCIPLE?**

First, elements and nutrients are shown to plants which have zinc deficiency. If zinc deficiency occurs, the process of producing chlorophyll doesn't work so smoothly. This causes chlorosis that makes the leaves in the veins purple. As the leaves turn yellow due to chlorophyll loss, the plant gradually turns purple and eventually dies, which is called necrosis, death of tissues.

Second, because in growth medium, essential nutrients and some hormones occur. Each of them causes chlorosis or necrosis, so the hormone hormones and nutrients are added. This is called like "nutrient solution". Also, "growth hormone", essential hormone, may appear.

**COMPARISON OF QUALITY IMPROVEMENT**

As a result, these provide mass production of crops and their quality is improved. This makes plants in aeroponics technology and grow up much as they can. Also, this can be used in research, which is useful in the field of agriculture.

### P-S-1 Science&Technology

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### Engineering Structures and Materials Improving Efficiency of Indoor Smart Farm

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**Introduction**

Despite the rising demand for self-sufficient food security among the middle-aged, outdoor space to grow plants hardly exist in apartment buildings. Indoor smart farms provide artificial environments where city farmers can grow their own fruits and vegetables even without outdoor space.

**Methods**

Based on scientific theories, we analyzed how the engineering structures and materials of Indoor Smart Farm are improving its efficiency for farmers to use and manage the product, and for plants to grow in the artificial farm.

- 1. Scientific properties of indoor and outdoor cylinder
- 2. Strategy of plant growth and development
- 3. Growth rate of plant development
- 4. Material science

were used to find connections between technologies and organisms.

**Result: Engineering Structures and Materials of Garden Smart**

**WHEEL**

Light travels in straight lines. When we arrange the plants in horizontal lines, the LED should be arranged directly above it, in a rectangular shape. However, when the plants are on the left side, the LED should be placed on the right side. The LED lights on the wheel should be arranged in a circular shape.

**TRAY**

Indoor smart farms can grow plants in a tray. If you plant some food, you can cultivate plants after a month. Now you can grow plants on a tray. It has an effective temperature control system. It has a fan on the ceiling to increase the heat and fan on the wall to decrease the heat and circulate the air. According to the growth rate of the plants, the temperature of the air inside the tray to make the thermal equilibrium with the air from the outside, and the temperature does to make the thermal equilibrium with the air when temperature has increased through the LED. The LED which is on the ceiling helps plants grow faster. As before the tray when it grows to proper size, we transfer it to a wheel.

### P-S-2 Science&Technology

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### 2022 International Symposium Oleogel Technology : To Improve 3D printing Food Ink Problem

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**Introduction**

During 3D printed foods often require post-treatment such as heat treatment after injection, and the types of foods that do not require it are limited to candy or chocolate products. In particular, in order to make chocolate into a 3D printer, contains a considerable amount of saturated fat, which is harmful to health. To solve this problem, it is necessary to improve the oleogel technology, which is a semi-solid form of oil, which is stable at room temperature and flows at high temperatures, so it will be suitable for 3D printing. However, there have been no cases of using oleogel to solve 3D printer ink problems, and we are curious about why, so we investigated information about oleogel and its limitations.

**Chemical principle of Oleogel**

The three-dimensional structure of oleogel includes hydrogen bonds and van der Waals bonds. Hydrogen is partially positively charged and F, O, N, and H, which bond to hydrogen, are bonded because they have partial anions, and are involved in the ability of isomolecules such as proteins. Van der Waals force is a bond that occurs when electrons are locally concentrated and charged in nonpolar molecules and attractive act between molecules. Each bond is weaker and more excessive than a hydrogen bond, but when many bonds are present, it contributes to the stabilization of large molecules such as proteins.

**Structure of Oleogel**

1. Crystal growth (when the molecular weight is large)
  - Natural waxes, candle wax, beeswax, carnauba wax, rice bran wax
  - Monoglycerides, Diglycerides
  - Fatty acids + fatty alcohols
2. Self-assembly between molecules
  - Hydroxy steric acid, ricinoleic acid, sphingolipids
  - Phospholipids + tocopherols + tocopherol + lecithin
3. Polymer intermolecular Self Assembly
  - Carbohydrates : Hydrophilic (ethyl cellulose)
  - Hydrophobic (methyl cellulose, hydroxypropyl methylcellulose)
  - Proteins: hydrophobic (gelatin, hydrophobic (gelatin, gelatin, gelatin)
  - Proteins + polysaccharides, chitosan and chitos

**Conclusion**

As a result of examining various properties of oleogel,

### P-S-3 Science&Technology

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### The expectation effectiveness of agrobacterium method of GMO on food strategy

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**Introduction**

The global food problem has emerged as a trouble that mankind must solve. Food strategies will inevitably be the food production and being up with the pace of population growth. Also, food climate change, land pollution, resistance to the number of people by region are also the cause of food decrease suitable for future.

**Agrobacterium method**

**1) Agrobacterium**

- ① A bacterial agent that causes root cancer which uses roots and stems of crops such as grapes, potatoes, apples, and roses as a host.
- ② Green negative bacteria : a type of prokaryote cell in which the cell wall has a relatively small amount of peptidoglycan compared to gram-positive bacteria, but instead, has an outer membrane composed of lipopolysaccharides, lipoproteins, and other complex macromolecules.
- ③ A bacterial microorganism that relies on bacteria, secreted from plant roots. It has the characteristics of attaching to plants and parasites on it when nutrients in the culture medium.
- ④ It can cut out one of its own plasmid DNA and integrate the gene into the plant's genome to make genetic regulation and amino acids.

**2) Agrobacterium method**

- ① After removing the genetic region that makes crown cancer in the plasmid, it connects useful genes in the position.
- ② After extracting the useful gene into the chromosome of the plant cell, a transformation with a useful gene is created.
- ③ The transgene body introduced with the useful gene gene activates, undergoes a selection process and a re-differentiation process through the plant's growth and development.

**Advantage of Agrobacterium method**

- ① Insert a small number of genes repeatedly and insert genetic information into the chromosome directly
- ② The only known example of how genetic information can be transferred between different species

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## 이론적 배경

- 선행연구

- (3) Alginate bead를 이용한 약물전달시스템

- Alginate bead 속 약물의 방출 속도 연구
    - Alginate는 음전하 띠는 carboxyl group을 가짐
    - 용이온성 약물(좌)은 전하의 척력으로 방출 촉진, 양이온성 약물(우)은 정전기적 인력으로 방출 지연





## 1. 연구 동기 및 목적

본 동아리는 2022학년도 하나고-하늘고-북일고 문화학술교류전에서 “클라우드 시대, 환경친화적 데이터센터 운영 방안”이라는 주제로 학술교류를 진행하여 클라우드 및 오프레미스 환경에서의 저장장치치를 포함한 컴퓨팅 리소스 절약의 중요성과 지속가능성에 대해 알아본 바 있다. 이에 효과적인 리소스 절약 방안으로 딥러닝을 활용한 이미지 저장공간 최적화 기법에 대하여 후속연구를 진행하고자 한다. 본 연구에서는 Mission-Critical하지 않은 3-채널 RGB 이미지를 단일 채널 흑백 이미지로 변환하여 저장, 이후 이를 Tensorflow 기반 Pre-Trained CNN Model 및 직접 개발한 CNN Model을 사용하여 3-채널 RGB 이미지로 복구하는 과정을 거쳐 저장공간을 최적화하는 방안에 대해 연구하고자 한다.

## 2. 연구 내용

기존 디지털 이미지는 통상적으로 픽셀당 0-255 사이의 밝기값을 가지는 RGB 채널로 구성되어 저장된다. 이를 색상값을 무시한 흑백 이미지로 변환하여 저장하면 약 3배의 공간복잡도 개선 효과를 얻을 수 있다. 아카이브된 이미지 파일을 사용해야 할 경우 이를 다시 복원하는 과정을 거쳐야 하는데, 의료데이터 등의 Mission-critical한 환경에선 픽셀당 색상값의 중요도가 타 분야 대비 월등히 높으므로 해당 환경 또는 이와 유사한 중요도를 가지는 환경을 제외한 컴퓨팅 환경에선 정적 이미지를 포함한 포괄적인 영상자료를 저장하는 데에 해당 방안을 활용하고 있다. 해당 방안은 데이터를 손실시킴으로서 저장공간을 절약하는 방안으로 이를 복원했을 시 기존 이미지와 동일하거나 유사하다는 보장이 없다. 딥러닝은 이와 같은  $f(x) \rightarrow y$ 에서  $y$ 가 주어지지 않은 경우에 활용할 수 있는 기계학습 기법으로 본 연구에 적합한 기술적 방안이다. 기존 CNN 기반 Colorizer 알고리즘<sup>1)</sup>은 통상적으로 ReLU를 활성화함수로 가지는 Convolution Layer를 중첩하여 기존 흑백 자료를 모델로 구성하였는데, 본 연구는 활성화 함수를 달리하여 적합도 향상 및 손실 최소화를 목적으로 하며 Grayscale 이미지에서 도출한 3-채널 RGB 이미지와 Ground Truth 간 적합도 개선 알고리즘 또한 구현할 것이다.

## 3. 연구 방법

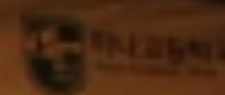
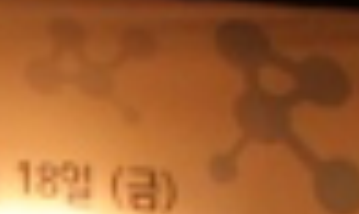
본 연구는 선행연구<sup>1)2)</sup>에서 통상적으로 사용한 다중 중첩 ReLU Convolution Layer<sup>Figure.1</sup>를 기반으로 하여 모델을 재구성하고자 한다. 기존 모델에서 발생할 수 있는 문제점에 대한 분석을 토대로 새로운 레이어를 구성하고, 기존 모델 대비 중첩 레이어를 줄여 본 연구에서 가용 가능한 컴퓨팅 환경에 적합한 모델을 설계하고자 한다. 가용 가능한 컴퓨팅 환경을 확정함에 있어 GAN(적대적 생성 신경망)의 도입이 망 중설 대비 나은 효율성을 보여줄 수 있을 거라 판단된다면 해당 방안을 도입하여 손실을 줄이도록 진행하고, 증가



2011학년도

# 하나고등학교 학술제

2011년 11월 18일 (금)



## 시간의 효율성

자발적  
순회로

선택형



유도형

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