Corona Project
From a late night email to a production facility and MORE!!!

Sulalit Bandyopadhyay & Corona Team
Agenda

• Project Overview
• Team and Organization
• Outreach
• Plans
• Research Possibilities
• Questions & Discussion
PROJECT OVERVIEW
Corona Virus

Spherical Virus

- Consists of a membrane of proteins and lipids.
- Conical protein – spike protein (S) which binds to cells in throat and lungs.
- RNA virus.
Current Situation

• Production Set-up
  – 9 reactors in Felles Lab + K4 413 (2 production lines)
  – 1 million tests a week

• Implementation in Health Care
  – All large hospitals in Norway

• Quality Assurance
  – Tests validated by at least two hospitals.

• Regulatory Status
  – Exemption from Norwegian Medicines Agency
How the Test Works?

1. A mucus sample is taken from the nose or throat.
2. The sample is mixed with a chemical solution that causes the protein envelope around the virus to crack open.
3. Magnetic nanoparticles are added to the solution. The virus’s RNA binds to the particles.
4. A magnet pulls the RNA and nanoparticles from the solution.
5. The RNA is released from the nanoparticles for analysis.
6. The RNA is analysed in a PCR machine which determines if the RNA is from the coronavirus.
IKP – Magnetic Nanoparticles
I. Research within Nanoparticles

Water flow can be traced with synthetic DNA sand

If your drinking water is contaminated, you’d no doubt like to find out where the pollution comes from. Researchers are working to make this easier.
Research within Nanoparticles

**Iron Oxide Nanoparticles:** For magnetic separation of the tracers.

**DNA:** Tracer Moiety

**Silica/Polymeric Shell:** Encapsulation and protection of the tracer. Mimicks sand particles
II. Chemical Engineering

- Reactors
- Upscaling
- Mixing
- Chemical Reaction Engineering
- Heat Transfer

A Chemical Engineer teaches Chemistry to Engineers and Engineering to Chemists 😊
III. Cross-Disciplinary Research
Production of Magnetic Beads for RNA Extraction/Isolation

- Metal Precursors + Reducing Agent
- Iron Oxide Nanoparticles
- Silanization
- Magnetic Beads
Work Flow

START

Equipment & Chemicals

Production Iron Oxide Nanoparticles

Day 0, 12:30

Characterization Iron Oxide Nanoparticles

Day 1, 10.30

Quality Control Iron Oxide Nanoparticles Mixing

Day 1, 10.30

Logging of results

Day 2, 12.00

Day 3, 10.30

Day 3, 16.30

Day 1, 14.00

Day 2, 12.00

Day 3, 14.00

Day 1, 10.30

Day 2, 09.00

Day 3, 10.30

Day 3, 16.30

Day 1, 10.30

Day 2, 12.00

Day 3, 14.00

Day 1, 14.00
Key Features

Technology

• High performance RNA extraction reagents for efficient COVID-19 testing.
• Contains a novel chemical composition for efficient lysis of virus and
• IKP-crafted magnetic nanoparticles with optimized high-affinity coating.
Key Features

Performance

- Sensitivity outcompetes current solutions for COVID-19 testing available on the market.
- Demonstrated in patient testing at three Norwegian hospitals.
Production Volumes

![Bar chart showing production volumes over time. The x-axis represents dates in April and May, and the y-axis represents tests per day. The chart shows a significant increase in production on May 11.]
Key Features

Uniqueness

• Current production volume of 1 million tests per week.
• Aim for 5 million tests per week by June 2020.
• Capacity scales up easily.
• Implemented in all major Norwegian hospitals for COVID-19 diagnostics since early April.
• Compatible with open robotic platforms.
• Tested on KingFischer, TECAN, Hamilton and BIOMEK robots.
• Enables purification of RNA/DNA from various pathogens and starting materials (i.e. sputum, swab, urine).
Key Features

Availability

• Actively seeking industry partners for global distribution.
• Overall goal to increase test capacity and ease the burden of the pandemic.
• Two patents filed in two countries.
• 20 of 25 patient samples analysed showed lower Ct-values than the reference.

• Higher sensitivity for the NTNU-test.

• The NTNU COVID-19 test is analysed with a 180-case set-up and shows compliance with 177/180 tests.

• The precision of the method is verified by reproducibility and repeatability of CV<10%.
TEAM & ORGANIZATION
Dept. of Chemical Engineering, NTNU (IKP)

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Magnar Bjørås
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Sten Even Erlandsen
Chief Engineer

Per Arne Aas
Senior Engineer

Dept. of Medical Microbiologt, St Olavs

Janne Fossum Malmring
Senior Biomedical Laboratory Scientist
Production Line - I
Production Line - II
Characterization Line
OUTREACH
Her reddes Norges testkapasitet

De sitter på nøkkelen som kan gjenåpne Norge og har blitt hyllet av helsemyndighetene. Dagbladet fikk bli med inn i det helligste av det hellige - der coronatestene lages.

NTNU-metode er avgjørende: Nå kan så å si alle koronatestes

Efter seks uker i krisestand, er vi desperarte etter å komme tilbake til normal hverdag. Og nå er det mulig: Vi skal teste mange – og isolere få.

NTNU bruker magnetiske kuler til å mangedoble kapasiteten for virustester

Verden er i ferd med å gå tom for virustester. NTNU har brukt en drøyt uke på å lage 150.000 testsett.
Potential Users

- Faroe Islands
- Denmark
- Netherlands
- India
- Pakistan
- Colombia
- Brazil +++
- Industrial Partners
PLANS
Plans – Production

• **Short-Term Plan (Until End of Jun 2020)**
  – Production continues at IKP.
  – Production for Norway and possibly for outside Norway.
  – Licensing of technology to international clients.

• **Plan During Transition (Jun – Dec 2020)**
  – Production continues within IKP facilities.
  – Licensing of technology to international clients.
  – Financial Mechanisms around commercialization.
  – Regulatory clearance.

• **Long-Term Plan ( Jan 2021 - )**
  – Establish Start-Up.
  – Commercial Production, R & D.

• Plans will be made in co-operation with IKP, IKPM and TTO.
RESEARCH POSSIBILITIES
Research Opportunities

- NTNU Funded PhD/Post Doc Positions – Shared between NV and MH Faculty.
- Cross-Disciplinary Research Centre.
- Externally Funded PhD/Post Doc Positions.
- SFF.
- Research Co-operation within IKP.
QUESTIONS & DISCUSSION

https://www.ntnu.edu/ntnu-covid-19-test