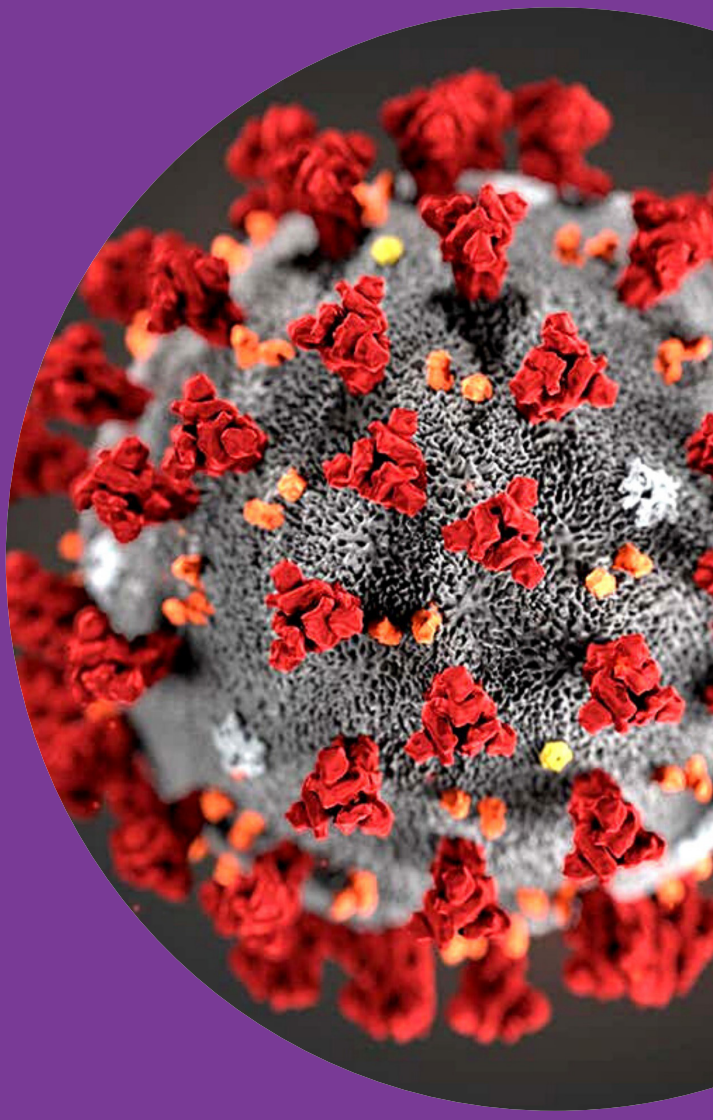
diamond

Healthcare

CASE STUDY

Characterising a next generation Covid vaccine



The Covid-19 (SARS-CoV-2) pandemic has claimed a global death toll of many millions of people and caused major disruption across the world. The development of mRNA vaccine technology has been a major scientific advancement from the pandemic with several vaccines now in development, undergoing trials and approvals or approved and in use.

The mRNA vaccines work by providing an mRNA copy of the target antigen (typically the SARS-Cov-2 spike protein) to the host cell allowing the cell to recognise the spike protein and prepare defences in advance of viral infection. Self-amplifying (sa) RNA vaccines represent the next generation of RNA vaccines which cause the host cell to multiply the number of copies of the target antigen RNA. The *in vivo* amplification allows the saRNA vaccine to be delivered at significantly lower doses, reducing side effects for patients.

cpi

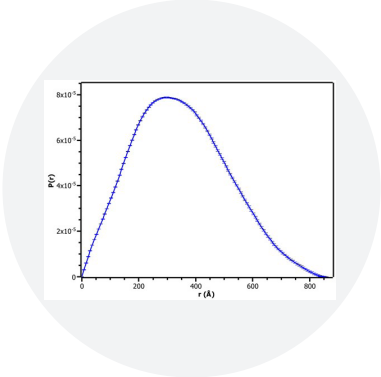
The Challenge

An RNA vaccine was developed by Imperial College London and manufactured at scale by the Centre for Process Innovation (CPI) in a programme to develop, manufacture and supply the saRNA Covid-19 vaccine funded via the UK Vaccine Taskforce. The extra self-amplifying code means that the RNA molecules are significantly larger than conventional mRNA vaccines making characterisation challenging for conventional bioanalytics methods due to the saRNA's large size and complex structure. New approaches for the characterisation of the saRNA molecule were needed to monitor the scaled up manufacturing process.

The Solution

The Imperial College London and CPI teams worked with scientists at Diamond to design and perform small angle X-ray scattering (SAXS) experiments using B21 to provide information on the shape and size of the RNA. The high brightness and fast measurements of the synchrotron allowed the team to perform size exclusion chromatography coupled with SAXS experiments allowing online purification of the RNA molecule and simultaneous structural characterisation. The SAXS measurements provided an assessment of the solution size of the RNA molecule and analysis suggest it is spherical in shape.

The Benefits



The information from the SAXS experiments was used along with other techniques to characterise several important biophysical parameters of the IMP-1 SARS-CoV-2 vaccine mRNA molecule. In particular, no degradation of the RNA was detected during the SAXS measurements, ensuring an accurate structural assessment. This provided the team with confidence that the expensive and complex manufacturing process was effective.

"The Covid pandemic was a challenging time for the scientific community, with the development of novel mRNA vaccine technology. I would like to thank the Diamond team for instrument access, experimental support and advice in determining the structure of the novel IMP-1 SARS-CoV-2 saRNA vaccine molecule. This work has laid the foundations for the biophysical characterisation of large RNA molecules in vaccine development and manufacture." **Dr Daniel Myatt, CPI**

For further information

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