Extreme nature helps scientists design nano materials

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Scientists are using designs in nature from extreme environments to overcome the challenges of producing materials on the nanometre scale. A team from the UK's John Innes Centre, the Scripps Research Institute in California and the Institut Pasteur in Paris have identified a stable, modifiable virus that could be used as a nanobuilding block.

Viral nanoparticles (VNPs) are ideally sized, can be produced in large quantities, and are very stable and robust. They can self-assemble with very high precision, but are also amenable to modification by chemical means or genetic engineering.

Some applications of VNPs require them to withstand extremely harsh conditions. Uses in electrical systems may expose them to high temperatures, and biomedical uses can involve exposure to highly acidic conditions. VNPs able to remain functional in these conditions are therefore desirable. The team identified viruses from the hot acidic sulphurous springs in Iceland. One of these, SIRV2, was assessed for its suitability for use as a viral nanobuilding block.

SIRV2 is a virus that infects Sulfolobus islandicus, a single-celled microorganism that grows optimally at 80°C and at pH 3, and it was also able to withstand other harsh environments created in the laboratory. This shows that the rigid, rod-shaped SIRV2 virus capsule must be very stable, an important characteristic for use as a nanobuilding block. To be potentially useful as a VNP, the viral capsule also needs to be open to modification or decoration with functional chemical groups.

The researchers found that, depending on the chemistry used, modifications could be targeted specifically to the ends of the virus particle, to its body, or both. This spatially controlled modification is unique to this VNP, and opens up new possibilities when the nanobuilding blocks are built up into arrays or layers. Since the virus body and ends can be selectively labelled it is expected that arrays with different physical properties can be fabricated, for example by aligning particles body-to-body versus self-assembly end-to-end. This option is not possible with other rod-shaped VNPs.

"Future applications may be found in liquid crystal assembly, nanoscale templating, nanoelectronic and biomedical applications." said Dr Dave Evans of the John Innes Centre.

"Further studies towards the development of these VNPs for materials are currently underway", said Dr Nicole F. Steinmetz of the Scripps Research Institute. "We are looking into the use of the particles to generate complex structures such as rings or tetrapods".

This work will be published in journal *Advanced Functional Materials* on November 10th.

Source: Norwich BioScience Institutes