Order from disorder

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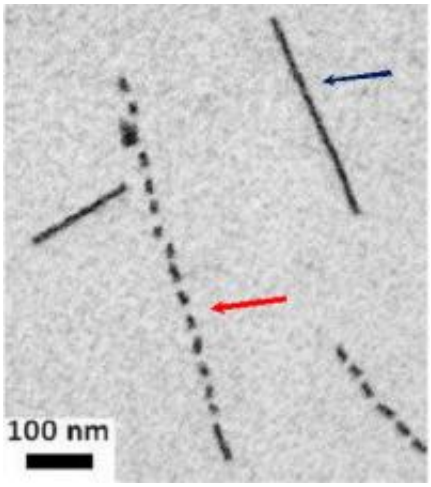

Electron microscopy image of contiguous and intermittent alpha-synuclein fibrils. The blue arrow indicates a contiguous fibre and the red arrow indicates an intermittent fibre.

NPL and University of Leicester scientists have explored a new way of ordering proteins for materials engineering at the nanoscale, using natural biological phenomena as a guide.

The researchers looked at alpha-synuclein, a protein associated with neurological diseases such as Parkinson's, Alzheimer's and some dementias, and found that it can form chain-like fibrillar structures with nanoscale regularity and precision (see image). The protein is intrinsically disordered in vitro, when isolated from the body, and clumps together to form insoluble aggregates which then arrange

themselves into long, thin fibres. Interestingly, these fibres can either be contiguous (blue arrow) or intermittent (red arrow).

In this study the researchers were able to demonstrate that this phenomenon can be emulated by artificially introducing regions of structural disorder into an unrelated, so-called 'designer' fibre. The gaps between the different segments and within the arrays themselves could be controlled and used as templates to synthesis further arrays of metal nanoparticles or biological molecules.

This concept could be used to engineer novel nanoscale materials and devices such as integrated biosensors and nanoarrays, for diagnosing disease or studying proteins. Using protein self-assembly in this way would prove more efficient and cost effective than traditional techniques, which require complicated instruments and tightly controlled environmental conditions.

The results are also important as they indicate a possible mechanism to detect and target the alpha-synuclein protein in the treatment of neurological diseases.

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