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Nanofiber breakthrough holds promise for medicine and microprocessors

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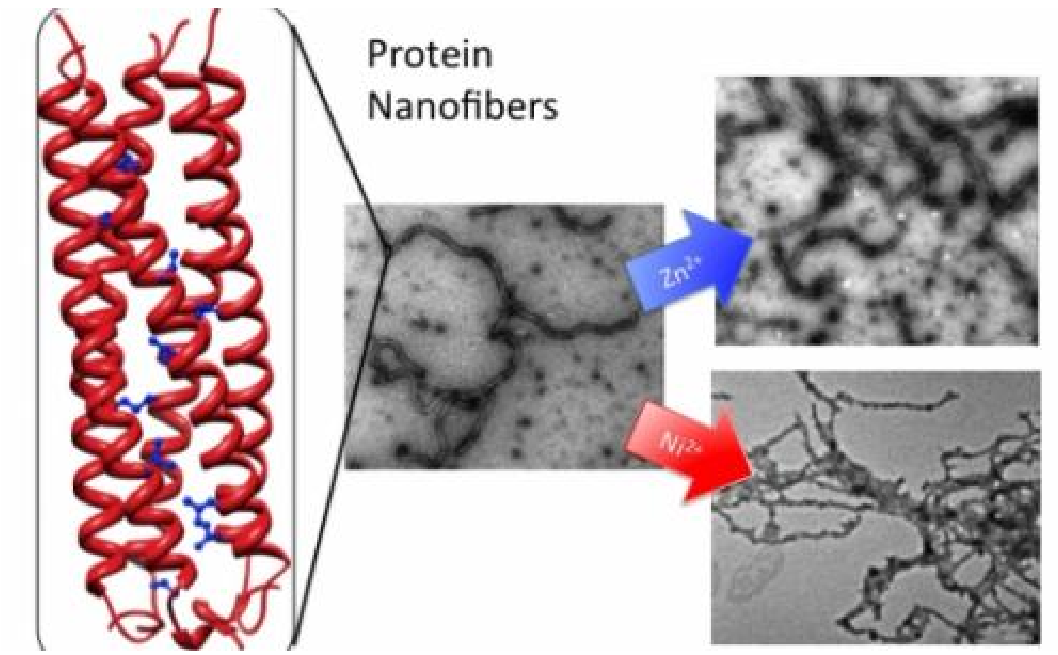

(PhysOrg.com) -- A new method for creating nanofibers made of proteins, developed by researchers at Polytechnic Institute of New York University (NYU-Poly), promises to greatly improve drug delivery methods for the treatment of cancers, heart disorders and Alzheimer's disease, as well as aid in the regeneration of human tissue, bone and cartilage.

In addition, applied differently, this same development could point the way to even tinier and more powerful microprocessors for future generations of computers and consumer electronics devices.

The details are spelled out in an article titled "Effects of Divalent Metals on Nanoscopic Fiber Formation and Small Molecule Recognition of Helical Proteins," which appears online in Advanced Functional Materials. Author Susheel K. Gunasekar, a doctoral student in NYU-Poly's Department of Chemical and Biological Sciences, was the primary researcher, and is a student of co-author Jin Montclare, assistant professor and head of the department's Protein Engineering and Molecular Design Lab, where the underlying research was primarily conducted. Also involved were co-authors Luona Anjia, a graduate student, and Professor Hiroshi Matsui, both of the Department of Chemistry and Biochemistry at Hunter College (The City University of New York), where secondary research was conducted.

Yet all of this almost never emerged, says Professor Montclare, who explains that it was sheer "serendipity" — a chance observation made by Gunasekar two years ago — that inspired the team's research and led to its significant findings.

During an experiment that involved studying certain cylinder-shaped proteins derived from cartilage oligomeric matrix protein (COMP, found predominantly in human cartilage), Gunasekar noticed that in high concentrations, these alpha helical coiled-coil proteins spontaneously came together and self-assembled into nanofibers. It was a surprising outcome, Montclare says, because COMP was not known to form fibers at all. "We were really excited," she recalls. "So we decided to do a series of experiments to see if we could control the fiber formation, and also control its binding to small molecules, which would be housed within the protein's cylinder."

Of special interest were molecules of curcumin, an ingredient in dietary supplements used to combat Alzheimer's disease, cancers and heart disorders.

By adding a set of metal-recognizing amino acids to the coiled-coil protein, the NYU-Poly team succeeded, finding that the nanofibers alter their shapes upon addition of metals such as zinc and nickel to the protein. Moreover, the addition of zinc fortified the nanofibers, enabling them to hold more curcumin, while the addition of nickel transformed the fibers into clumped mats, triggering the release of the drug molecule.

Next, Montclare says, the researchers plan to experiment with creating scaffolds of nanofibers that can be used to induce the regeneration of bone and cartilage (via embedded vitamin D) or human stem cells (via embedded vitamin A).

Later, it may even be possible to apply this organic, protein-based method for creating nanofibers to the world of computers and consumer electronics, Montclare says — producing nanoscale gold threads for use as circuits in computer chips by first creating the nanofibers and then guiding that metal to them.

Ultimately, Montclare says, the researchers would like the fruits of their discovery — such therapeutic nanofibers and metallic nanowires — to be adopted by pharmaceutical companies and microprocessor makers alike.

More information: onlinelibrary.wiley.com/doi/10 … m.201101627/suppinfo

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