'Self-assembly' technique for making cheap, high-density data storage

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Imagine being able to store thousands of songs and high-resolution images on data devices no bigger than a fingernail. Researchers from A*STAR's Institute of Materials Research and Engineering (IMRE) and the National University of Singapore (NUS) have discovered that an ultra-smooth surface is the key factor for "self-assembly".

Self-assembly is a a cheap, high-volume, high-density patterning technique. It allows manufacturers to use the method on a variety of different surfaces. This discovery paves the way for the development of next generation data storage devices, with capacities of up to 10 Terabits /in2 which could lead to significantly greater storage on much smaller data devices.

The "self-assembly" technique is one of the simplest and cheapest high-volume methods for creating uniform, densely-packed nanostructures that could potentially help store data. Self-assembly is one of the leading candidates for large scale nanofabrication at very high pattern densities. One of its most obvious applications will be in the field of bit patterned media, or the hard disk industry . It is widely used in research and is gaining acceptance in industry as a practical lithographic tool for sub-100 nm, low-cost, large area patterning. However, attempts to employ self-assembly on different surface types, such as magnetic media used for data storage, have shown varying and erratic results to date. This phenomenon has continued to puzzle industry researchers and scientists globally.

Researchers from A*STAR's IMRE and NUS have now solved this mystery and identified that the smoother the surface, the more efficient the self-assembly of nanostructures will be. This breakthrough allows the method to be used on more surfaces and reduce the number of defects in an industrial setting. The more densely packed the structures are in a given area, the higher the amount of data that can be stored.

"A height close to 10 atoms, or 10 angstroms in technical terms, is all it takes to make or break self-assembly," explained Dr MSM Saifullah, one of the key researchers from A*STAR's IMRE who made the discovery. This is based on a root mean squared surface roughness of 5 angstrom. The team discovered that this was the limit of surface roughness allowed for the successful self-assembly of dots, which could eventually be used in making high-density data storage. "If we want large scale, large area nanopatterning using very affordable self-assembly, the surface needs to be extremely smooth so that we can achieve efficient, successful self-assembly and with lower incidences of defects."

The discovery was recently published in *Scientific Reports*, an open access journal from *Nature.*

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