Nano World: Rapidly scanning nano impacts

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Scientists could rapidly track potential impacts nanoparticles could have on cells via a new technique employing infrared scans, experts told UPI's Nano World.

As materials and devices possessing components only nanometers or billionths of a meter in size grow more popular in everything from cosmetics to clothes and electronics to pharmaceuticals, concern is growing among scientists, officials, industry and the public about the risk of harm or unintended effects nanoparticles could have on health and the environment. The incredibly tiny proportions of these materials can make them behave quite differently from more conventionally sized compounds, but much remains unknown about what biological effects nanomaterials could have.

Often screening a compound for any potential toxicity involves running it through a battery of tests that each typically investigate what effect that material has when it comes to one or a handful of the many biomolecules found in cells. Such tests consume time and money, and when it comes to nanomaterials, another concern is they might impact molecules tests generally do not screen for.

To investigate the damage that nanoparticles might wreak, material scientist S.K. Sundaram and toxicologist Thomas Weber at Pacific Northwest National Laboratory in Richland, Wash., and their colleagues are developing a method that in one go scans for all the biological effects a given substance might have on live cells. Scientists can basically monitor cells before, during and after testing them with a nanomaterial.

Within minutes, these scans return a vast amount of data representing the infrared signatures of an untold number of chemical bonds.

Currently the plan is to dose cells with compounds that each have a specific, known biological effect, such as inflammation, and scan the results. Then scientists would compare that information with the data generated after cells get exposed to a specific nanomaterial. While the infrared scans cannot specify which exact molecules a nanomaterial might affect, they could in theory detect patterns characteristic of a particular biological effect, Weber explained. He and Sundaram presented findings on Feb. 17 at the annual meeting of the American Association for the Advancement of Science in St. Louis.

The investigators are now analyzing macrophages, immune cells linked with lung responses to nanomaterials. Scientists grow the cells on plates much as they would on Petri dishes, save these plates are made of zinc selenide, which is transparent to rays from these Fourier transform infrared or FTIR spectroscopy scans.

Currently the researchers coat the plates with the fibrous protein fibronectin for the cells to grow on, but this protein layer can be relatively thick, which can lead to poor results. Sundaram is currently working on combinations of amines, silanes and carboxylic acids for layers for cells to attach to less than one nanometer high.

Not only can this new technique analyze the potential impact of nanoparticles on cells, but "any other compounds, for example new pharmaceuticals, could also use this system to test for toxicity," said pulmonary toxicologist Clark Lantz at the University of Arizona in Tucson. While "their preliminary work shows great promise," Lantz added much work remains ahead, such as determining the sensitivity, reproducibility and specificity of the responses these scans yield.