New developments in nanotechnology tackle the two biggest problems associated with chemotherapy

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Huixin He, associate professor, nanoscale chemistry at Rutgers University, Newark, and Tamara Minko, professor at the Rutgers Ernest Mario School of Pharmacy, have developed a nanotechnology approach that potentially could eliminate the problems of side effects and drug resistance in the treatment of cancer. Under traditional chemotherapy, cancer cells, like bacteria, can develop resistance to drug therapy, leading to a relapse of the disease.

As reported in the December 21, 2009, issue of the journal *Small*, He, Minko and their co-researchers, including investigators from Merck & Co. and Carl Zeiss SMT, a global nanotechnology firm, have designed nanomaterials that allow for the targeted and simultaneous delivery of a chemical drug to destroy cancer cells and a genetic drug to prevent drug resistance.

"We modified the surface of mesoporous silica nanoparticles so that an anticancer drug, doxorubicin, could be loaded into the pores of the silica nanoparticles. Also loaded onto the nanoparticles was a genetic drug designed to prevent or remove multidrug resistance outside the nanoparticles," explained He.

When administered to multidrug-resistant ovarian cancer cells, the nanoparticle treatment was more than 130 times more lethal than when doxorubicin was administrated alone . Most importantly, "the drug can

only be released when it is inside the cancer cells. This controlled internal release mechanism can dramatically eliminate side effects associated with anticancer drugs to normal tissues," He noted.

Battling Aggressive Breast Cancer with Nanotubes

In related research, Professor He and another team of co-researchers have developed single-walled carbon nanotubes, consisting of cylinders of carbon about a nanometer in length, that hold the potential of providing a more effective means for detecting and selectively destroying aggressive breast cancer cells.

In a paper published in BMC Cancer late last year, the researchers showed that by chemically bonding a special antibody onto the nanotubes and taking advantage of two unique optical properties of carbon nanotubes (strong Raman scattering and near infrared absorption), single cancer cells can be detected and selectively eradicated while leaving the nearby normal cells unharmed. A uniqueness of this approach is that it offers the advantage of being more easily extended to other types of cancer cells. He's research in the areas of cancer detection and treatment is funded in part with grants from the National Science Foundation and National Cancer Institute.

Research Focuses on Practical Applications Across a Wide Range of Fields

The application of He's nanotechnology research is far and wide. In other research, He and members of her lab at Rutgers are working on the practical application of nanomaterials as a molecular diagnostic tool for Parkinson's disease. Other research is focused on the development of a platform to detect the presence of chemical warfare agents for homeland defense. And in yet other research, He and her lab members are working

on nanotechnology to precisely and selectively measure iron ions (Fe^{3+}) in remote ocean atmosphere dust and sea water, which is critical for the study of greenhouse gases and climate change .

At Rutgers, He teaches an undergraduate course in analytical chemistry and graduate courses in electrochemical analytical chemistry and a new course she designed in scanning probe microscopy. She is the recipient of the 2009 Rutgers Presidential Fellowship for Teaching Excellence.

More information: To learn more about He's research, visit andromeda.rutgers.edu/~huixinhe/huixinhe.html .

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