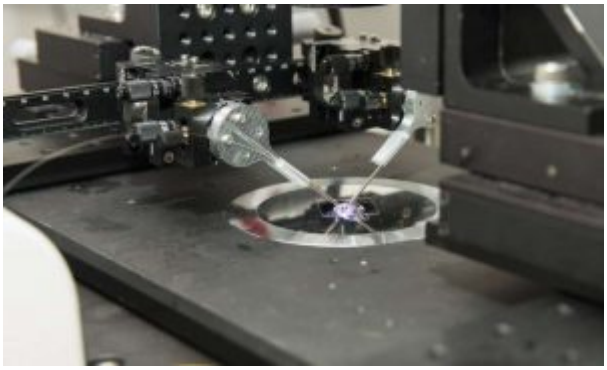
Researchers taking optical device out of the lab and into the clinic to detect cancer at its earliest stages

In a paper published in Nature Scientific Reports, a team of researchers at Worcester Polytechnic Institute (WPI) has demonstrated how a device that uses beams of light to grip and manipulate tiny objects, including individual cells, can be miniaturized, opening the door to creating portable devices small enough to be inserted into the bloodstream to trap individual cancer cells and diagnose cancer in its earliest stages.

The technique, known as optical tweezers, uses optical beams of laser light to create an attractive force field that can hold, or trap, small objects in place without physical contact. Traditional optical tweezers focus the light with a large and expensive lens, which makes the device bulky and susceptible to environmental fluctuations. These limitations make optical tweezers impossible to use outside the lab.



“Currently, to test for cancer, you must wait until there’s a visible tumor or a sufficient volume of cancerous cells in a blood sample,” he said. “By that time, the cancer may be advanced. But cancer starts with single cells. If doctors

could separate those cells from among millions of blood cells, we could detect cancer much sooner—at a point where it's not visible using other techniques. This could advance diagnoses by months or even years and make treatment much more successful."

Read more at: https://phys.org/news/2017-12-optical-device-lab-clinic-cancer.html#jCp

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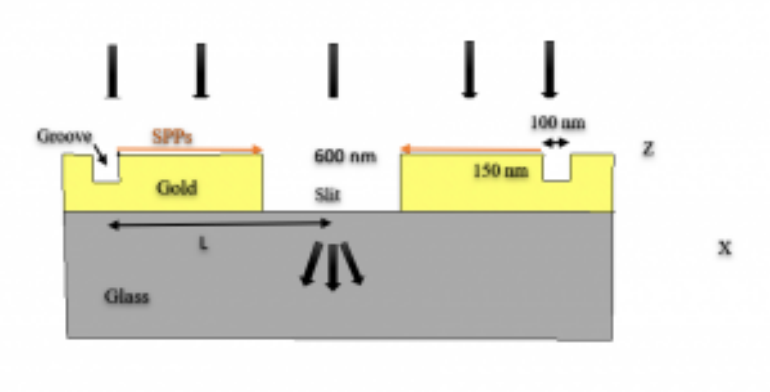
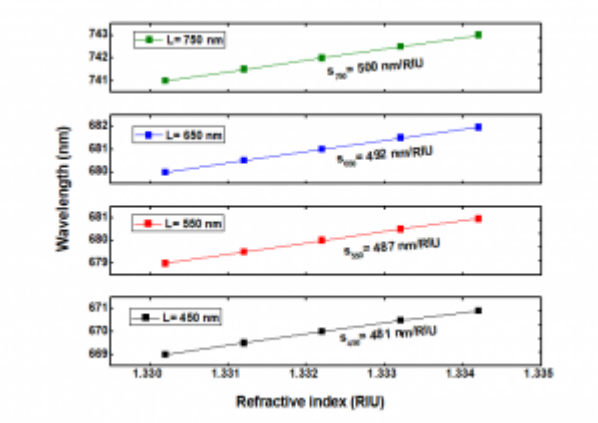
Our new paper in optics communication

Congratulations for the publication of paper" Highly Sensitive Biochemical sensor based on Nanostructured Plasmonic Interferometer" , by Khajemiri , S. M. Hamidi , Om. K. Suwal.

We propose a novel plasmonic interferometric sensor with a slit and surrounding rectangular grooves array on an optically thick gold film for biochemical sensing. We did finite-difference time-domain (FDTD) simulation for design optimization and analytical calculation for characterization of sensitivity in the proposed sensor. Our interferometer is functional for visible to near infrared region with maximum sensitivity of 500 nm/RIU and figure of merit 1933 at 741 nm wavelength. The peak intensity and wavelength change in different refractive indices. In conclusion, the results obtained in the present study indicate the potential of the proposed plasmonic interferometer as a low cost, compact, and label-free high-throughput device.

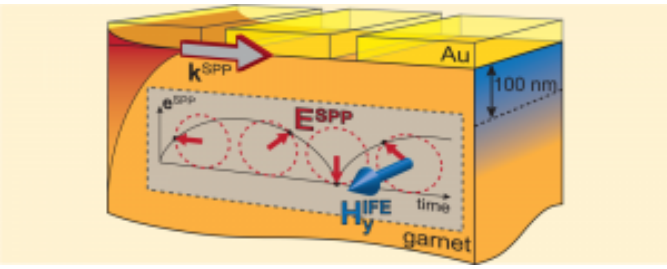




Surface Plasmon-Mediated Nanoscale Localization of Laser-Driven sub-Terahertz Spin Dynamics in Magnetic Dielectrics

We report spatial localization of the effective magnetic field generated via the inverse Faraday effect employing surface

plasmon polaritons (SPPs) at Au/garnet interface. Analyzing both numerically and analytically the electric field of the SPPs at this interface, we corroborate our study with a proof-of-concept experiment showing efficient SPPdriven excitation of coherent spin precession with 0.41 THz frequency. We argue that the subdiffractional confinement of the SPP electric field enables strong spatial localization of the SPP-mediated excitation of spin dynamics. We demonstrate two orders of magnitude enhancement of the excitation efficiency at the surface plasmon resonance within a 100 nm layer of a dielectric garnet. Our findings broaden the horizons of ultrafast spin-plasmonics and open pathways toward nonthermal optomagnetic recording on the nanoscale.



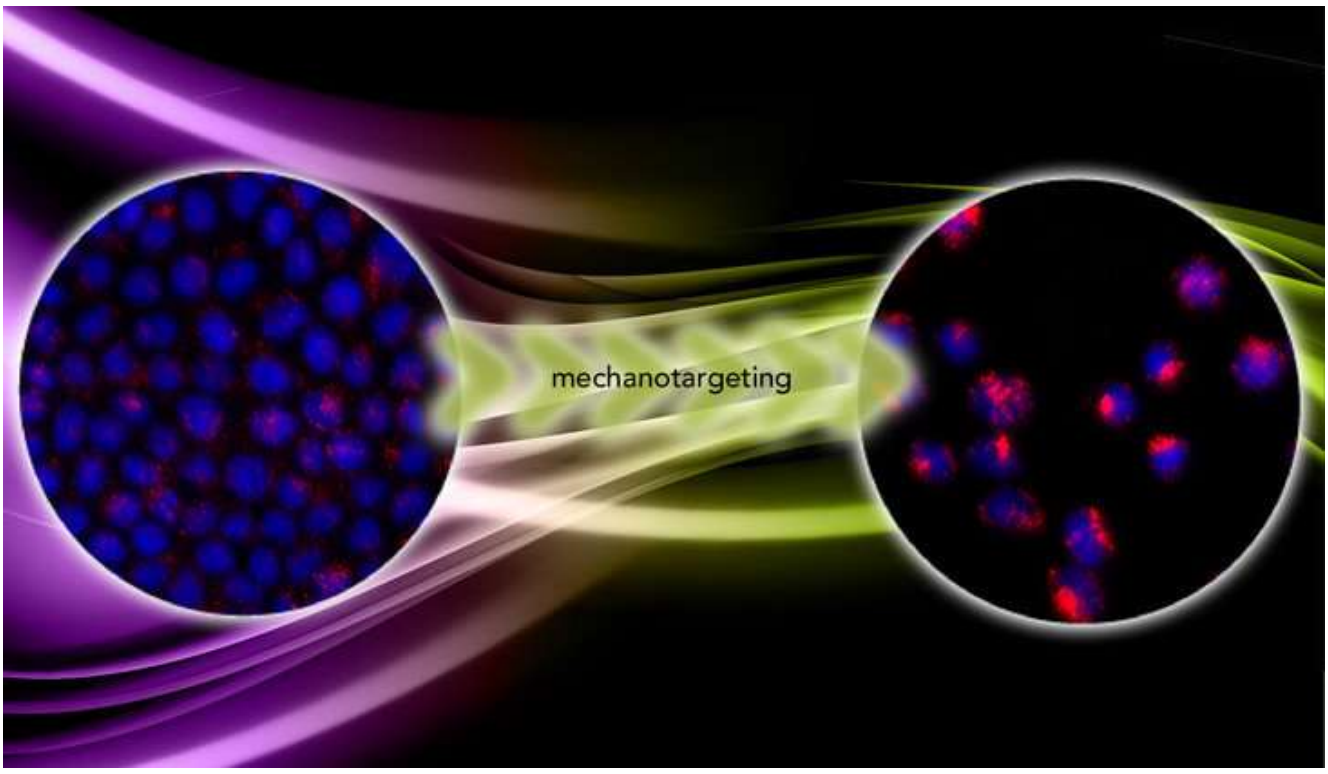
KEYWORDS: Ultrafast spin dynamics, surface plasmon−polariton, inverse Faraday effect, rare-earth iron garnet, nonlinear optics, Magnetoplasmonics

Effective static magnetic field induced by a propagating SPP at the Au/magnetic garnet interface.

https://pubs-acs-org.ezp3.semantak.com/doi/10.1021/acs.nanolett.8b00416

Targeting strategy may open door to better cancer drug delivery

Bioengineers may be able to use the unique mechanical properties of diseased cells, such as metastatic cancer cells, to help improve delivery of drug treatments to the targeted cells, according to a team of researchers at Penn State.



Many labs around the world are developing nanoparticle-based, drug delivery systems to selectively target tumors. They rely on a key-and-lock system in which protein keys on the surface of the nanoparticle click into the locks of a highly expressed protein on the surface of the cancer cell.

The adhesive force of the lock and key is what drives the nanoparticle into the cell, said Sulin Zhang, professor of engineering science and mechanics.

The resistive force is the mechanical energy cost required for

the membrane to wrap around the nanoparticle. Until now, bioengineers only considered the driving force and designed nanoparticles to optimize the chemical interactions, a targeting strategy called “chemotargeting.” Zhang believes they should also take into account the mechanics of the cells to design nanoparticles to achieve enhanced targeting, which forms a new targeting strategy called “mechanotargeting.”

“These two targeting strategies are complementary; you can combine chemotargeting and mechanotargeting to achieve the full potential of nanoparticle-based diagnostic and therapeutic agents,” Zhang said. “The fact is that targeting efficiency requires a delicate balance between driving and resistive forces. For instance, if there are too many keys on the nanoparticle surface, even though these keys only weakly interact with the nonmatching locks on normal cells, these weak, off-target interactions may still provide enough adhesion energy for the nanoparticles to penetrate the cell membrane and kill the healthy cells.”

In “Mechanotargeting: Mechanics-dependent Cellular Uptake of Nanoparticles,” On soft hydrogels the cells remained cohesive and benign and experienced a nearly constant stress that limited the uptake of the nanoparticles. But on stiff hydrogels the cells became metastatic and adopted a three-dimensional shape, offering more surface area for nanoparticles to adhere, and became less stressed. Under this condition, the cells took up five times the number of nanoparticles as the benign cells.

“The nanoparticles are fluorescent, so we count the number of nanoparticles that get into the cell by the fluorescence intensity. We found that in the malignant cells the intensity is five times higher,” Zhang said. “That proves that mechanotargeting works.”

Explore further: Nanoparticle aggregates for destruction of

cancer cells

More information: Qiong Wei et al, Mechanotargeting: Mechanics-Dependent Cellular Uptake of Nanoparticles, *Advanced Materials* (2018). DOI: 10.1002/adma.201707464

Journal reference: Advanced Materials.

Provided by: Pennsylvania State University .

Read more at: https://phys.org/news/2018-06-strategy-door-cancer-drug-delivery.html#jCp