NANOSHELLS FOR ENERGY, MEDICINE AND RESEARCH

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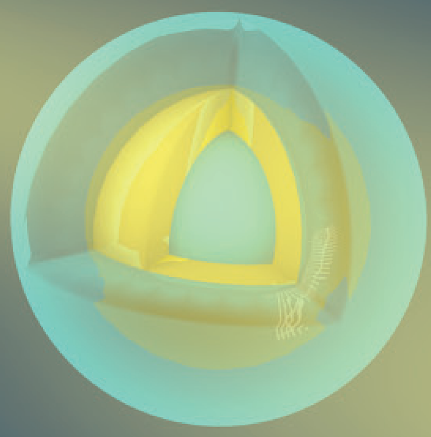
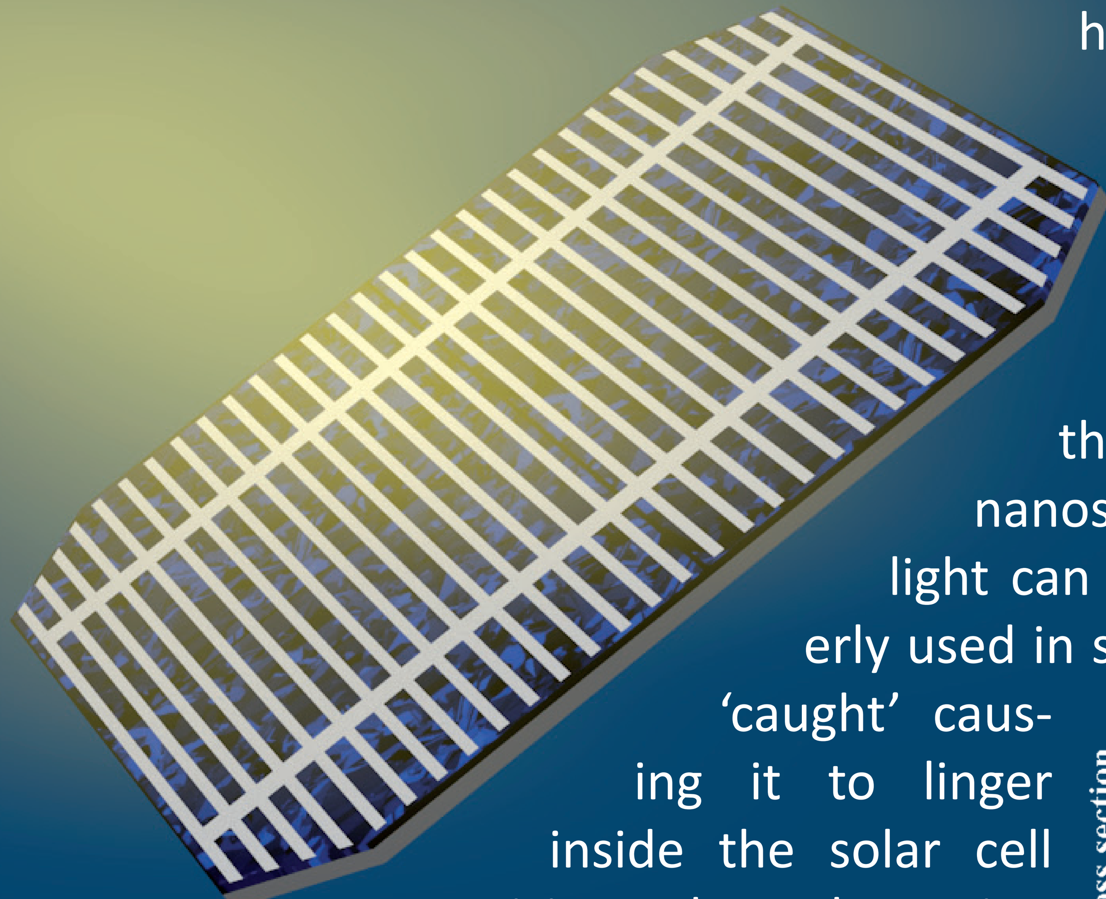
NANOSHELLS

At the cutting edge of nanotechnology new particles emerge, bearing new kinds of applications and providing yet another tool to tackle some of the harsh issues in the world. *Sustainability*, *environment* and *green energy* are some of the keywords for these applications, putting a lot of demands on the particles at hand.

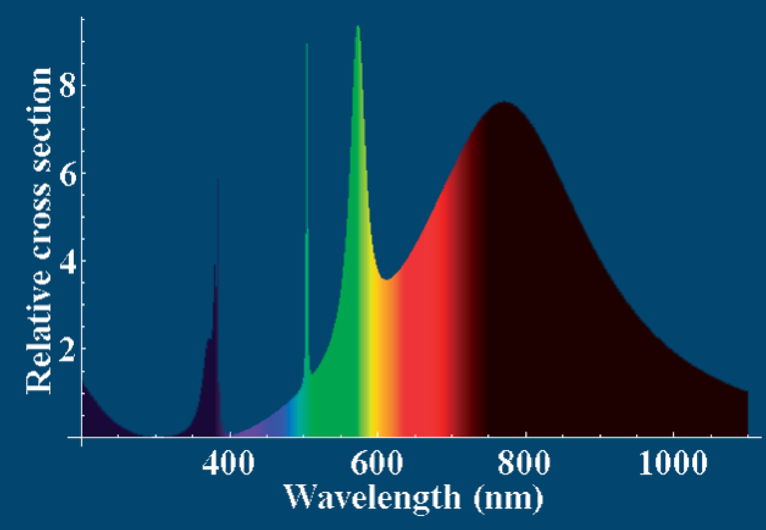


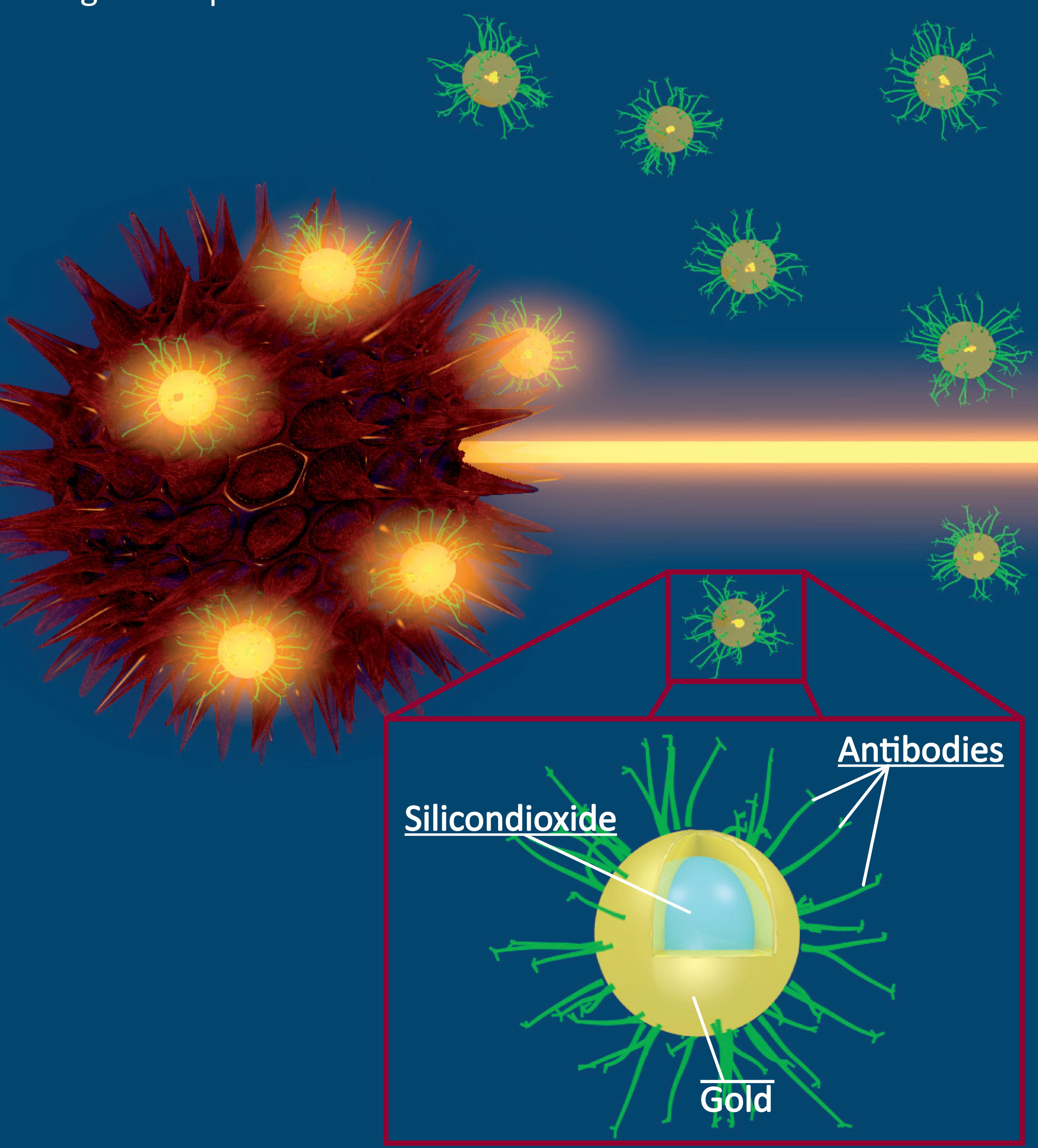
But one type of particle seems to be able to provide it all. Nanoshells, both flexible and cheap to produce, might just be the answer a lot of people are looking for. Existing only a decade, the number of applications already outstretches other nanoparticles and continues to grow. Whether it is increasing the efficiency of a solar cell, measuring the pressure or finding and fighting cancer cells, the optical properties of nanoshells can have a great impact on their environment and *vice versa*.

ENERGY: solar cells



Our current usage of fossil fuels guarantees a shortage in the near future. To prevent that our world will grind to a halt other energy supplies will have to be found. Solar cells are a sustainable option with promising properties for the future. And now they can be improved even more through nanotechnology. Using nanosystems, such as nanoshells, the light can be redirected and more properly used in solar cells. But light can also be 'caught' causing it to linger inside the solar cell raising the absorption and the overall efficiency. Soon increasing the efficiency of a solar cell can be as simple as sprinkling nanoparticles over its surface.





MEDICINE: Biosensors

The real advantage of nanoshells is that they can be tuned according to the needs of an experiment. By changing the sizes of the core and the shell the resonance frequency at which they respond can be chosen throughout the visual and near-infrared spectrum. Furthermore, this frequency will change once something changes in the environment of the shell. This makes the nanoshell an excellent probe. By attaching antibodies they become heat-seeking missiles targeting specific molecules or cells. Once there it is easy to find these nanoshells and thus the cell you're looking for.

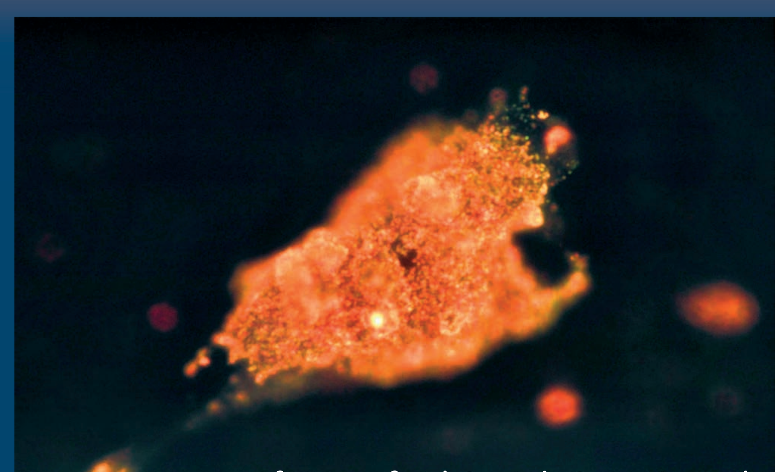


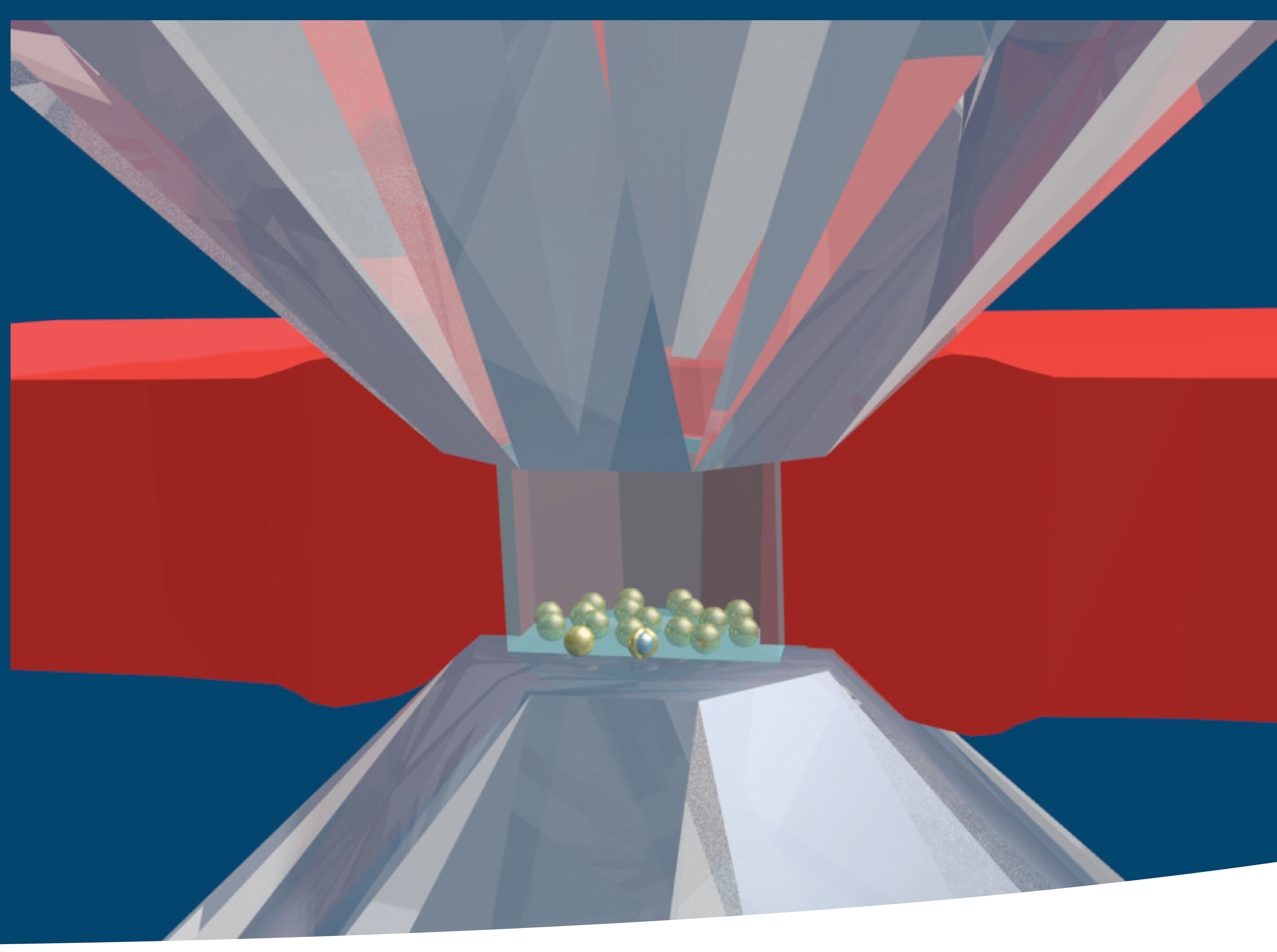
Image courtesy of Mostafa El-Sayed, Georgia Tech.

In *cancer ablation* scientists went one step further. After tagging cancer cells with golden nanoparticles, they used gold's photo-thermal properties to heat up the particles around the cell, a treatment the cancer couldn't stand for long.

RESEARCH: high pressure gauges

Applications of nanoshells can be found in fundamental physics as well. The study of materials under extreme pressures is interesting for engineers and scientists alike. Pressures resembling what can be found in the core of the earth can be reached in a *diamond anvil cell* by pressing two diamonds together. However, it is challenging to measure the actual pressure in the cell. Only recently the idea of using nanoshells as pressure gauges has been developed with very promising results.

As the pressure increases, the shells will be compressed, resulting in a changed optical response. This can be easily detected using absorption or extinction spectroscopy. This is very similar to the current ruby pressure gauges, but with the advantage of the tunability of nanoshells, allowing one to steer clear of the optical properties of the diamonds themselves. Furthermore, the nanoshells can be used as a heat source as well, making experiments under high pressures and temperatures possible.



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