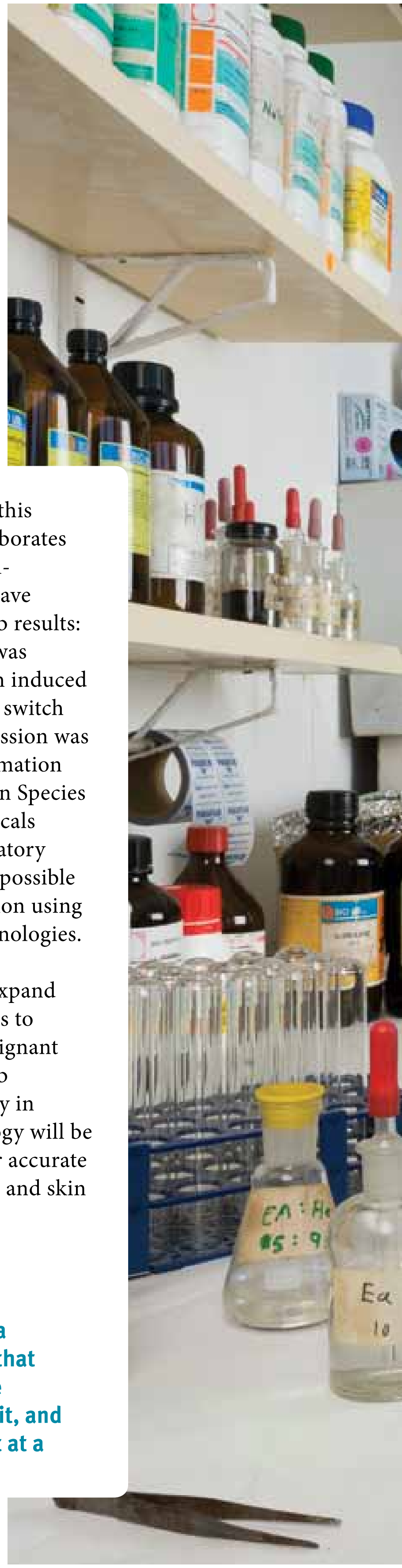
Marked for Removal

Residual cancer cells can initiate renewed cancerous growth even after the surgical removal of a tumor. Prof. Doron Shabat, Raymond and Beverly Sackler School of Chemistry, applies nanometric technology to develop sensors that will mark malignant cells, so the surgeon can remove each and every cancer cell.



"Surgeons face tough questions when removing malignant tumors: Have they successfully excised all malignant cells? Have they accurately determined the borders of the tumor, so as not to endanger patients by removing healthy tissue?" explains Prof. Shabat. "We are developing diagnostic methods for marking malignant cells, and making them visible to surgeons through optical imaging."

Prof. Shabat's research group utilizes nanotechnology to create a unique organic molecule that will act as a sensor when injected into the patient's body. The sensor will have a switch—a substance that identifies the disease agent, interacts with it, and impels it to emit light at a given wavelength. The surgeon, seeing the light, will be able to identify and completely remove malignant tissue.

The team faces two key challenges: (1) creating a switch that will emit light upon contact with the disease agent; (2) controlling light wavelength, which must be in a range not absorbed or emitted by surrounding tissue. (From 600–900 nanometers, close to infrared range.) Dr. Shabat's solution is based on an innovative chemical engineering design for fluorescent molecules. "Up until now, fluorescent molecules were built of two zones: an electron donor zone and an electron acceptor zone," says Prof. Shabat. "We offer a different approach: we construct a triangle—a molecule with one donor zone and two acceptor zones. The defense team—the switch—is connected to the donor area, and as long as it is in place, no light is emitted. When the switch is removed, an electron passes from the donor to one of the acceptors, which then emits light." In this manner it is possible to create a modular library of substances for a variety of applications.

Nanometric carriers are needed to deliver marker molecules to diagnostic sites. To this end, Prof. Shabat collaborates with Prof. Ronit Satchi-Fainaro. Researchers have obtained significant lab results: a switched-off sensor was injected into mice with induced inflammation, and the switch that prevents light emission was removed at the inflammation site by Reactive Oxygen Species (ROS)—oxidizing radicals typical of the inflammatory condition. It was then possible to view the inflammation using available imaging technologies.

Prof. Shabat seeks to expand the system's capabilities to identify and mark malignant tumors—initially in lab animals, and eventually in humans. This technology will be particularly helpful for accurate identification of breast and skin cancer cells. ●

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Prof. Doron Shabat, Raymond and Beverly Sackler School of Chemistry, leads a research group in bioorganic chemistry. His research has been key to the development of innovative molecular systems for control-release drugs at target sites, biomedical diagnostics, and identifying disease-causing agents. Prof. Shabat has published over 70 scientific papers and has contributed chapters to select books.