Engineering and Computer Science 2012

"I think the biggest challenge in my area of research is for scientists to leave their ivory towers and go out and see the real world, find relevant problems and apply their skills and expertise in material science to those problems."

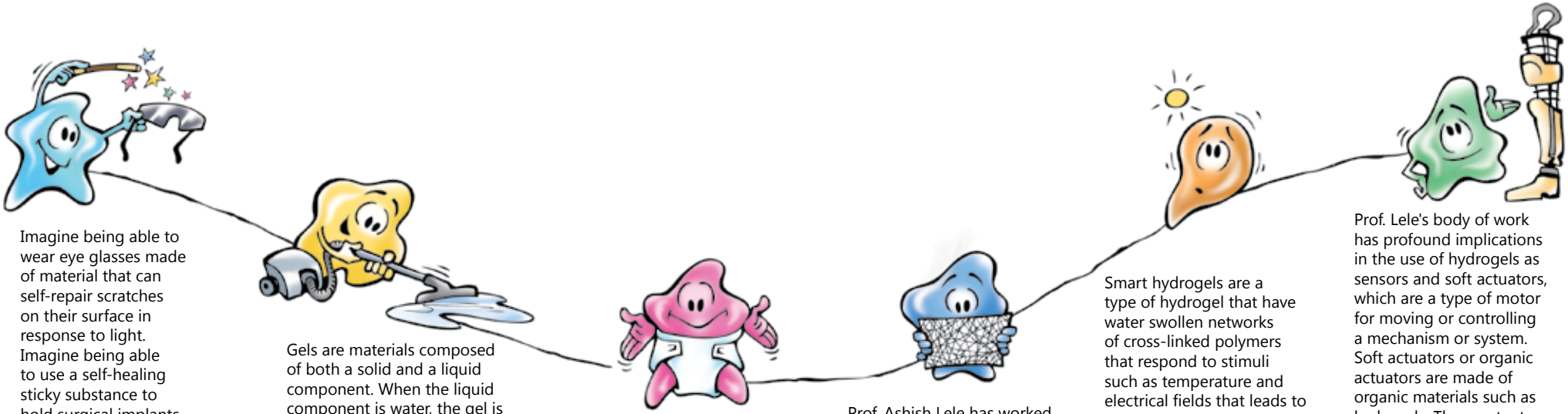
Ashish Lele

Senior Principal Scientist, National Chemical Laboratory, Pune

- B.Chem. Eng. from the Department of Chemical Technology, University of Bombay
- Ph.D. in Chemical Engineering from the University of Delaware

Prof. Ashish Lele has made many novel and impactful contributions to polymer science and engineering. These include molecular tailoring of stimuli responsive smart hydrogels, new insights into the anomalous rheological behavior of complex fluids and the coupling of macromolecular dynamics and polymer processing.

Exploring the many uses of hydrogels



Imagine being able to wear eye glasses made of material that can self-repair scratches on their surface in response to light. Imagine being able to use a self-healing sticky substance to hold surgical implants in place instead of stitches. If you think this is science fiction, think again. Such substances are already found in nature and over the years, scientists have been trying to create them in laboratories.

Gels are materials composed of both a solid and a liquid component. When the liquid component is water, the gel is called a hydrogel. A hydrogel is usually composed of a polymer network. Polymers are large chain-like molecules made up of monomers which are smaller molecules. Hydrogels have super absorption capabilities, and are also highly flexible. They are similar to natural tissue.

Over the years hydrogels have found many uses in several areas especially in medical science. They are commonly used in cell culture, tissue engineering, and sustained release drug delivery systems. They are also used in everyday items such as disposable diapers to soak in more fluid.

Prof. Ashish Lele has worked extensively with hydrogels and has been probing the microstructures in polymeric materials at the molecular and mesoscopic (the intermediate length between microscopic and macroscopic) length scales.

Smart hydrogels are a type of hydrogel that have water swollen networks of cross-linked polymers that respond to stimuli such as temperature and electrical fields that leads to volume phase transitions. Prof. Lele's work revealed that under the influence of these stimuli, the cylindrical shape of the hydrogel changes spontaneously into a coconut-like structure, which is also reversible.

Prof. Lele's body of work has profound implications in the use of hydrogels as sensors and soft actuators, which are a type of motor for moving or controlling a mechanism or system. Soft actuators or organic actuators are made of organic materials such as hydrogels. These actuators are able to act on their external environment by changing input energy into mechanical work. These are extremely important in medical devices such as prosthetic limbs, as they improve their strength and performance.