More than a million people with type 1 diabetes—an autoimmune disease that is life-threatening unless treated with frequent doses of insulin—will soon be able to check their blood sugar levels without the daily drawing of their own blood.

A team of researchers, led by mechanical engineering associate professor Qiao Lin, has invented a microfabricated, miniature sensor that can eventually be implanted in a patient’s body for long-term, continuous glucose monitoring. It will be part of a closed-loop system that will automatically deliver insulin to diabetic patients based on blood sugar levels.

Lin’s glucose sensor consists of a microscopic diaphragm (or cantilever), which vibrates under remote magnetic excitation in a microchamber filled with a glucose-sensitive polymer solution. When glucose enters the chamber through a semipermeable membrane, it binds reversibly with the polymer, changing the viscosity of the solution. As the viscous damping on the diaphragm vibration directly depends on the viscosity, the glucose concentration can be determined by wireless vibration measurements. Depending on the result, insulin can be injected to maintain a normal glucose level.

The reversible binding of glucose to the polymer is key.

“It is a physical process and so the glucose is not consumed,” says Lin. This is a key difference between his device and current, less reliable, sensors that use an irreversible electrochemical reaction of glucose with an enzyme.

Lin, who earned his PhD from the California Institute of Technology, was a postdoctoral scholar in Caltech’s Electrical Engineering Department and an assistant professor of mechanical engineering at Carnegie Mellon University prior to joining the SEAS faculty.