Inexpensive, Portable Glucose Monitor for Diabetics via a Crosslinked Sensing Fluid

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Diabetes mellitus currently affects over 346 million people worldwide and is one of the leading causes of death. Current treatment requires frequent blood-glucose tests followed by necessary insulin injection to avoid diabetes-related complications. Manufacture and use of blood-glucose monitors can be costly, as tests need to be performed multiple times daily, and sometimes inaccessible to large diabetic populations in developing countries. This research aimed to develop an inexpensive and simple alternative to current glucose monitoring technologies without the need for expensive materials and accessories through construction of a glucose-responsive fluid (GrF). The GrF created was composed of boric acid crosslinked with polyvinyl alcohol (PVA) which provided crosslinking sites selectively displaced by presence of glucose. Once glucose dissociated the crosslinks among PVA chains, viscosity of GrF decreased, resulting in accelerated flow through a viscosity tube. Therefore, viscosity, recorded in terms of time, was selected as output for glucose concentration. Glucose concentrations covering healthy and diabetic ranges were selected to test viscosity change of GrF. Results demonstrated that higher glucose concentrations corresponded with less time for GrF to pass through viscosity tube and each glucose concentration tested had unique signal readout (time). Potential interfering species (lactic acid, sucrose and in horse blood) were also evaluated and ensured GrF's selectivity to glucose. Cost analysis determined that material cost of single test using GrF is less than one cent. Results suggest possibility of utilizing GrF as an inexpensive, easy-to-operate glucose monitoring system for diabetics with potential for near-continuous measurements and global applicability.

Awards Won:
Fourth Award of $500