Inexpensive Glucose Monitoring Device for Diabetics Using Capillary Action of Crosslinked Sensing Fluid, Year II

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Diabetes 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 injections to avoid complications. Manufacture and use of blood-glucose monitors can be costly, as tests need to be performed frequently, and inaccessible to diabetic populations in developing countries. Last year, I successfully developed an inexpensive glucose-responsive fluid (GrF) capable of detecting glucose concentrations in all blood-glucose ranges, even maintaining selectivity to glucose in the presence of other species (lactate, sucrose, blood). GrF was composed of boric acid crosslinked with polyvinyl alcohol (PVA) which provided crosslinking sites selectively displaced by the presence of glucose. Once glucose dissociated crosslinks, GrF's viscosity decreased. As viscosity is an intrinsic property of GrF, it became of interest this year to engineer a device that could provide GrF viscosity measurements in a precise, portable, inexpensive and continuous manner. The device was created with capillary tubes embedded in polydimethylsiloxane: capillary action prompts immediate flow of samples in tube and distance travelled correlates to sample's viscosity- a function of glucose concentration. Glucose concentrations covering all blood-glucose ranges were tested and demonstrated GrF and device's accuracy in providing unique signal readouts (in terms of distance) for each glucose concentration. A cost analysis concluded that single test using GrF and device is less than 1 cent. Results suggest possibility of utilizing GrF and accompanying device as an inexpensive portable blood-glucose monitoring system with potential for near-continuous measurements and global applicability.

Awards Won:
Second Award of $2,000