5.3.4. DIABETES UNDER CONTROL: A MICRONEEDLE-BASED CONTINUOUS GLUCOSE MONITOR

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Diabetes is the leading cause of blindness, kidney failure and non-traumatic amputation of the lower limb. Further severe complications are neuropathy and heart disease. While frequent and long periods of hyperglycemic blood glucose levels account for these long-term complications, hypoglycemia can cause sudden coma and brain damage. Periodic fingerstick measurements fail to detect all hypoglycemic and hyperglycemic events since glucose levels can change rapidly. The capability to easily and continuously monitor the blood glucose level would be a tremendous improvement in the treatment of diabetes. A painless approach is to measure the glucose level of the interstitial fluid, which correlates well with the blood glucose level.

This abstract presents a “non”-invasive continuous glucose monitor using an array of hollow out-of-plane microneedles to penetrate the topmost layer of the skin and to sample glucose from the epidermal interstitial fluid. The glucose diffuses through an integrated dialysis membrane into dialysis fluid, which is pumped past an integrated enzyme-based glucose sensor (Fig. 1). Such a glucose monitor is easy to apply, painless and can be operated for about three days. No additional fingerstick measurements are required since the glucose sensor can be automatically recalibrated accounting for the loss of enzyme activity. A simplified prototype (Fig. 2) is fabricated and characterized using premixed glucose solutions. The response time of the system is only 2 min.

![Figure 1: Concept of the glucose monitor](image1)

![Figure 2: Photo of the prototype](image2)