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Temperature Correction in Optical Enzymatic Assays Using Thermochromic Liquid Crystals

Herschel Watkins

Pete Richards

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ABSTRACT

Many point of care devices use enzymatic assays to quantify the analyte of interest. Enzyme efficiency can be strongly temperature dependent. Therefore, it is important to correct for temperature effects during the analysis of experimental results. This disclosure describes techniques to correct for temperature effects in enzymatic assaying by using thermochromic liquid crystals in parallel with the enzymatic assay to track real time temperature variation at the assay location. Temperature can thus be tracked at the precise assay location, rather than at some nearby point. By thus directly and empirically measuring temperature at the location that matters, assumptions about the distribution of temperature can be eliminated. Accurate knowledge of the temperature at the exact point of assay is thus obtained, improving accuracy in situations where relatively small variations in temperature can cause significant variations in experimental results.

KEYWORDS

- Point of care device
- Enzyme
- Enzymatic assay
- Enzyme efficiency
- Thermochromic liquid crystal (TLC)
- Calibration curve

BACKGROUND

Many point of care devices use enzymatic assays to quantify the analyte of interest. Enzyme efficiency can be strongly temperature dependent. Therefore, it is important to correct for temperature effects during the analysis of experimental results. During operation, the devices are rarely in thermal equilibrium, as the sample, the driving electronics, the optics, the surrounding environment, etc. may be either heat sinks or sources. A further complication is the temperature dependence of the light source and photodiodes. As a result, measuring the temperature at a point distal to the assay may result in an incorrect temperature reading and an incorrect result.

A standard approach to correcting for temperature is to measure the temperature elsewhere in the device using a temperature gauge, which, as explained above, can result in erroneous results. Alternatively, the environment for the operation of the device can be restricted to a narrow temperature band. This may be insufficient to control for the thermal sensitivity of some enzymes, and, furthermore, can limit the practical utility of the device.

A multiplex reader analyzes multiple target analytes within a sample by combining optical signals emitted by differentially dyed fluorescent beads immersed in the sample. Thermochromic liquid crystals (TLC) are materials that exhibit color dependence on temperature.

DESCRIPTION

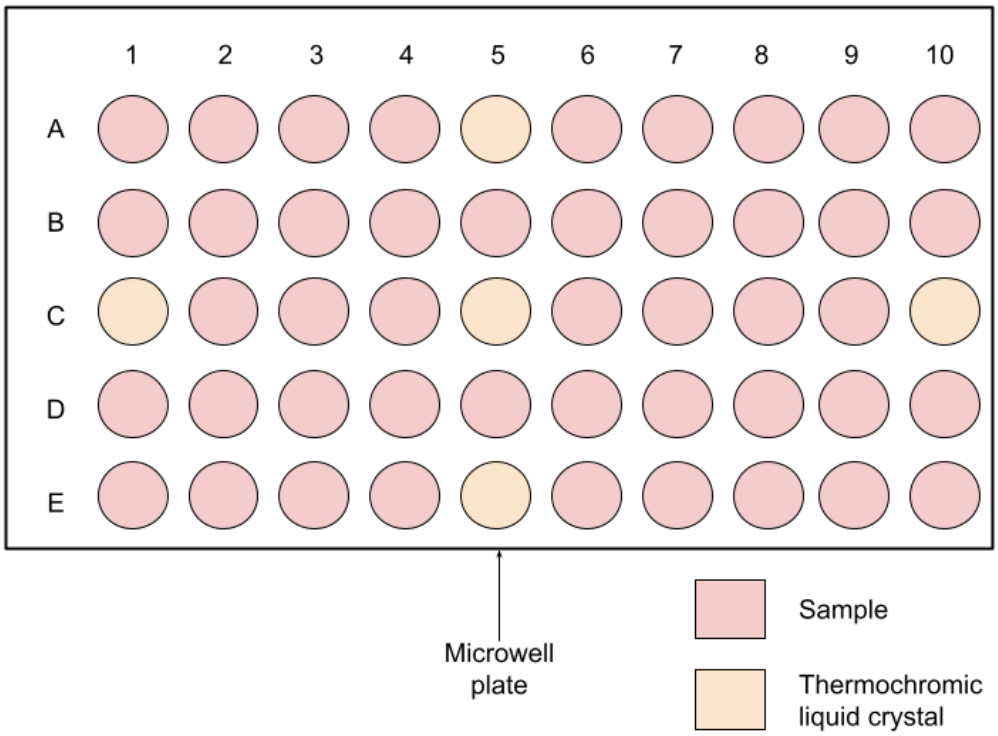

Fig. 1: Temperature correction in optical enzymatic assays using thermochromic liquid crystals

This disclosure describes techniques to correct for temperature effects in enzymatic assaying by using thermochromic liquid crystals in parallel with the enzymatic assay to track real time temperature variation at the assay location. In an example implementation, illustrated in Fig. 1, one or more spots (or wells) in a microwell plate of a multiplex reader can be dedicated to tracking temperature by replacing the enzymatic membranes (red) at certain spots with thermochromic liquid crystals (TLC, shown in yellow). Temperature can thus be tracked at precise assay locations, rather than at some nearby point.

Alternatively, a TLC can be used to directly measure the temperature at the point of assay to create calibration curves that account for more possible sources of temperature variation. By thus directly and empirically measuring temperature at the location that matters, assumptions

about the distribution of temperature can be eliminated. Accurate knowledge of the temperature at the exact point of assay can be of great importance in situations where relatively small variations in temperature can cause significant variations in experimental results.

CONCLUSION

This disclosure describes techniques to correct for temperature effects in enzymatic assaying by using thermochromic liquid crystals in parallel with the enzymatic assay to track real time temperature variation at the assay location. Temperature can thus be tracked at the precise assay location, rather than at some nearby point. By thus directly and empirically measuring temperature at the location that matters, assumptions about the distribution of temperature can be eliminated. Accurate knowledge of the temperature at the exact point of assay is thus obtained, improving accuracy in situations where relatively small variations in temperature can cause significant variations in experimental results.

REFERENCES

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