EVALUATION TEST OF QUANTUM DOTS IN HEAT TRANSFER APPLICATIONS:

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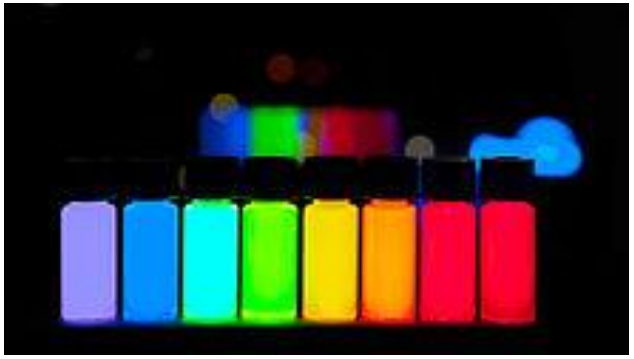
Authors: Husain Al Hashimi
Jungho Kim

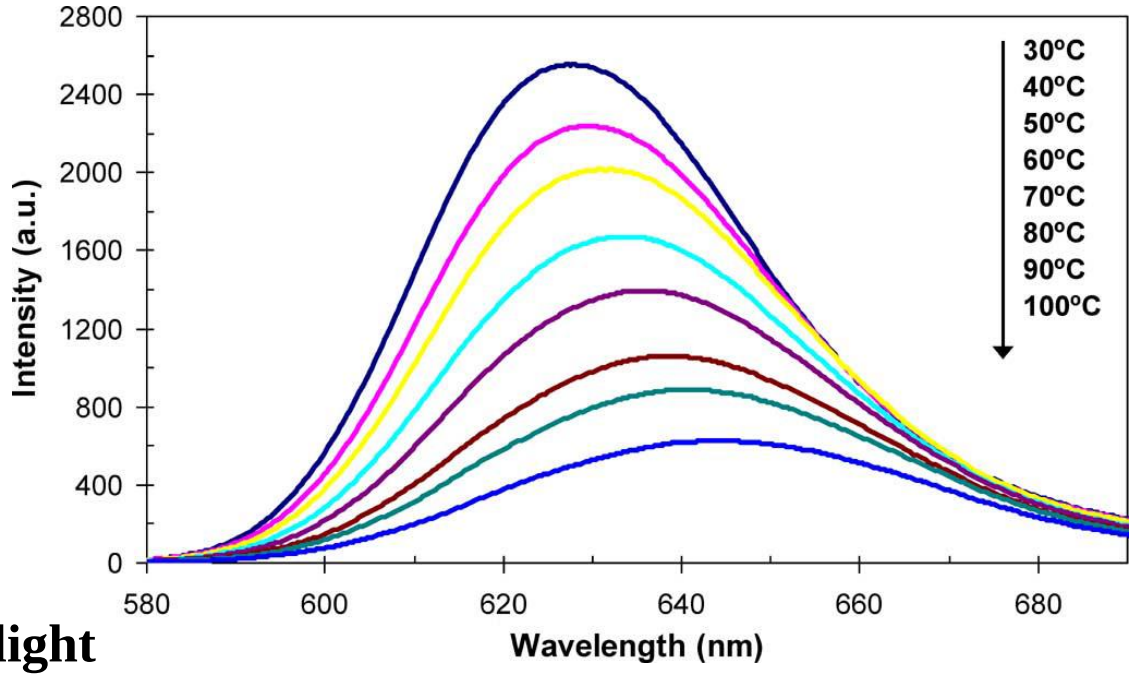
Institution: University of Maryland, College Park

Introduction

- Nano-size semiconductors
  - Tunable light emission spectrum, via particle size
  - High pixel and sensitivity resolution
  - Intensity and spectral characterization of Temperature

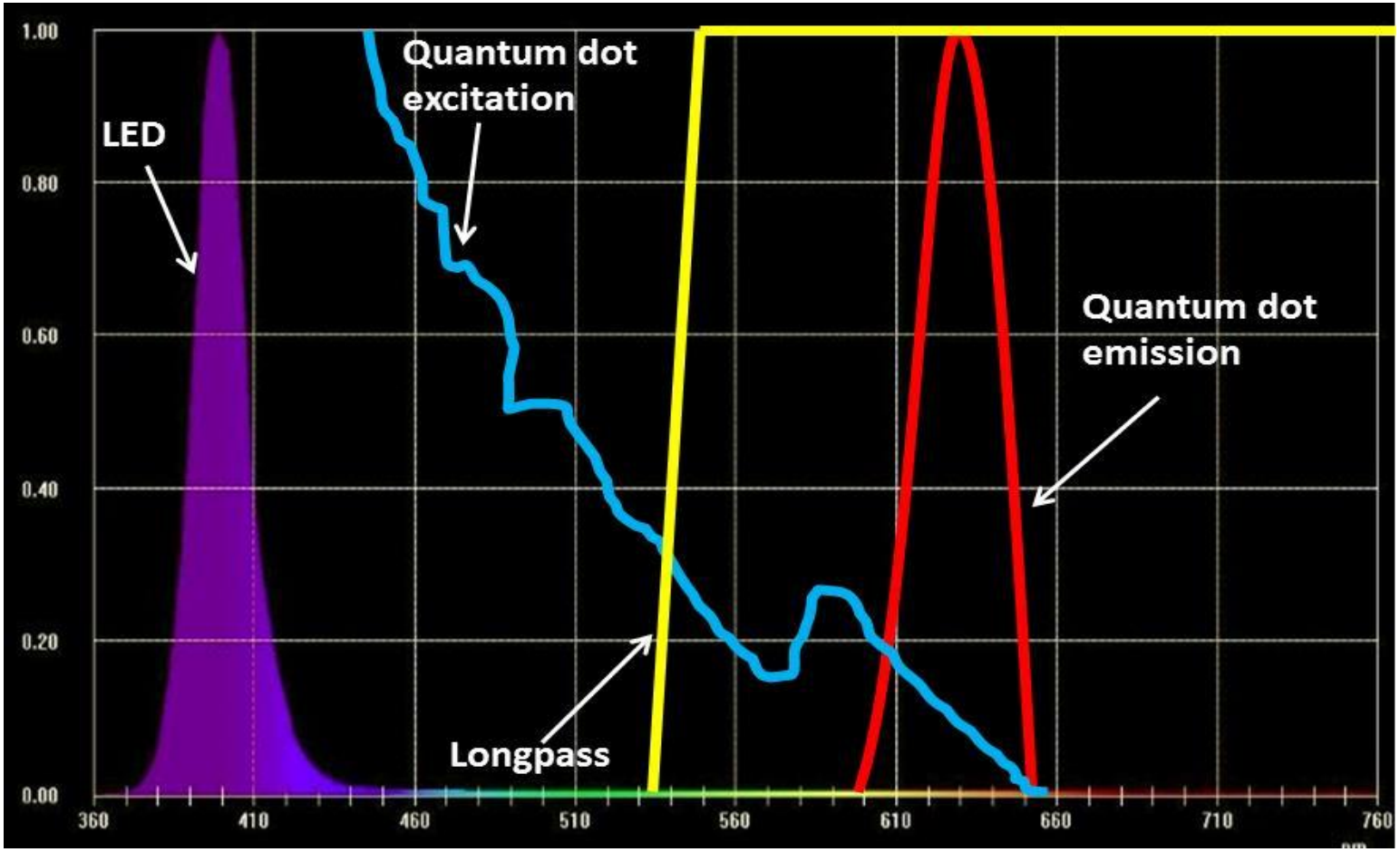


Variation of quantum dot light emission with particle size
(Courtesy of [1])



Intensity and spectral characteristics with temperature
(Courtesy of [2])

Optical Characterization



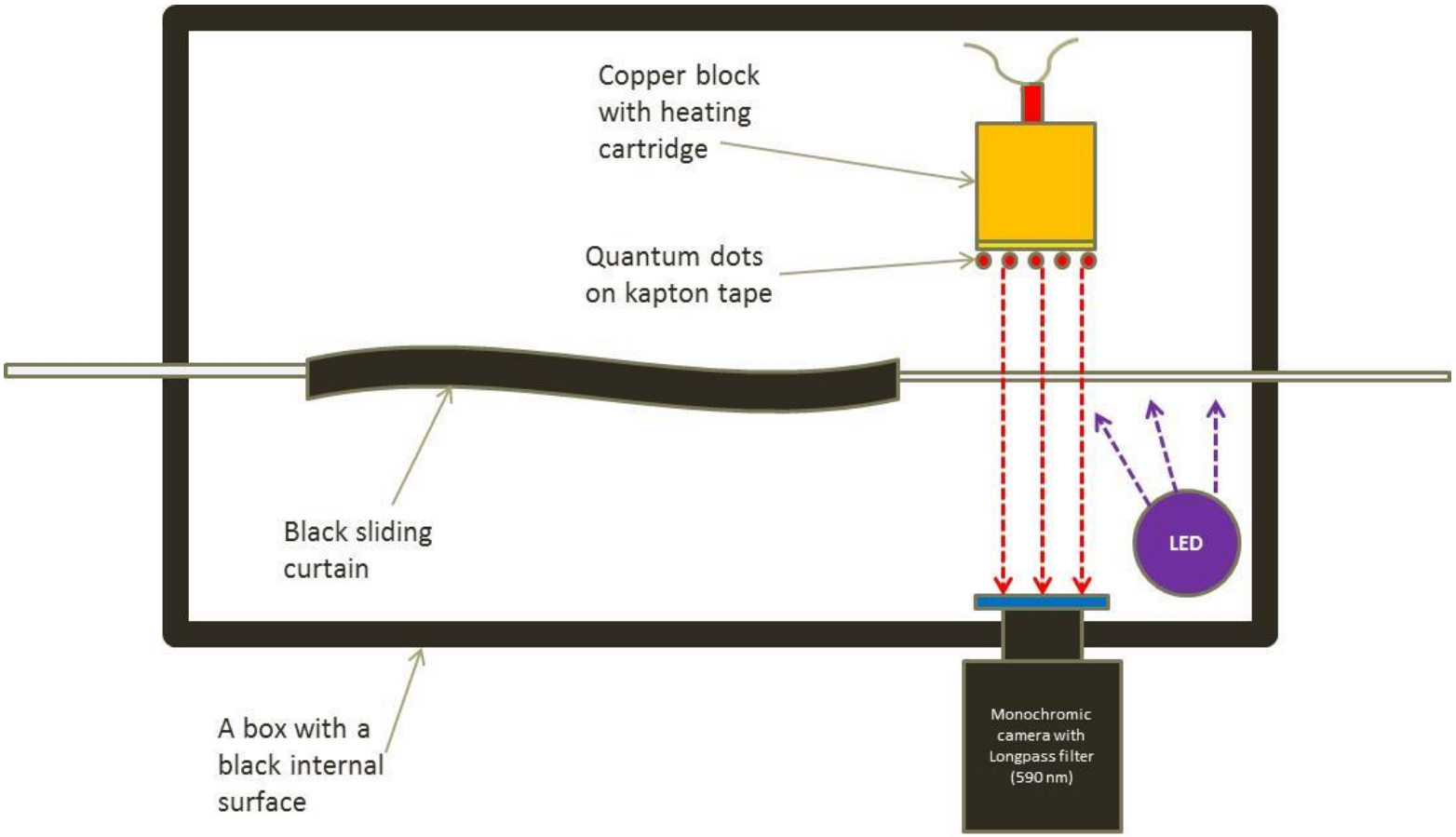
(Courtesy of [1,3-4])

Characterization of Quantum Dots

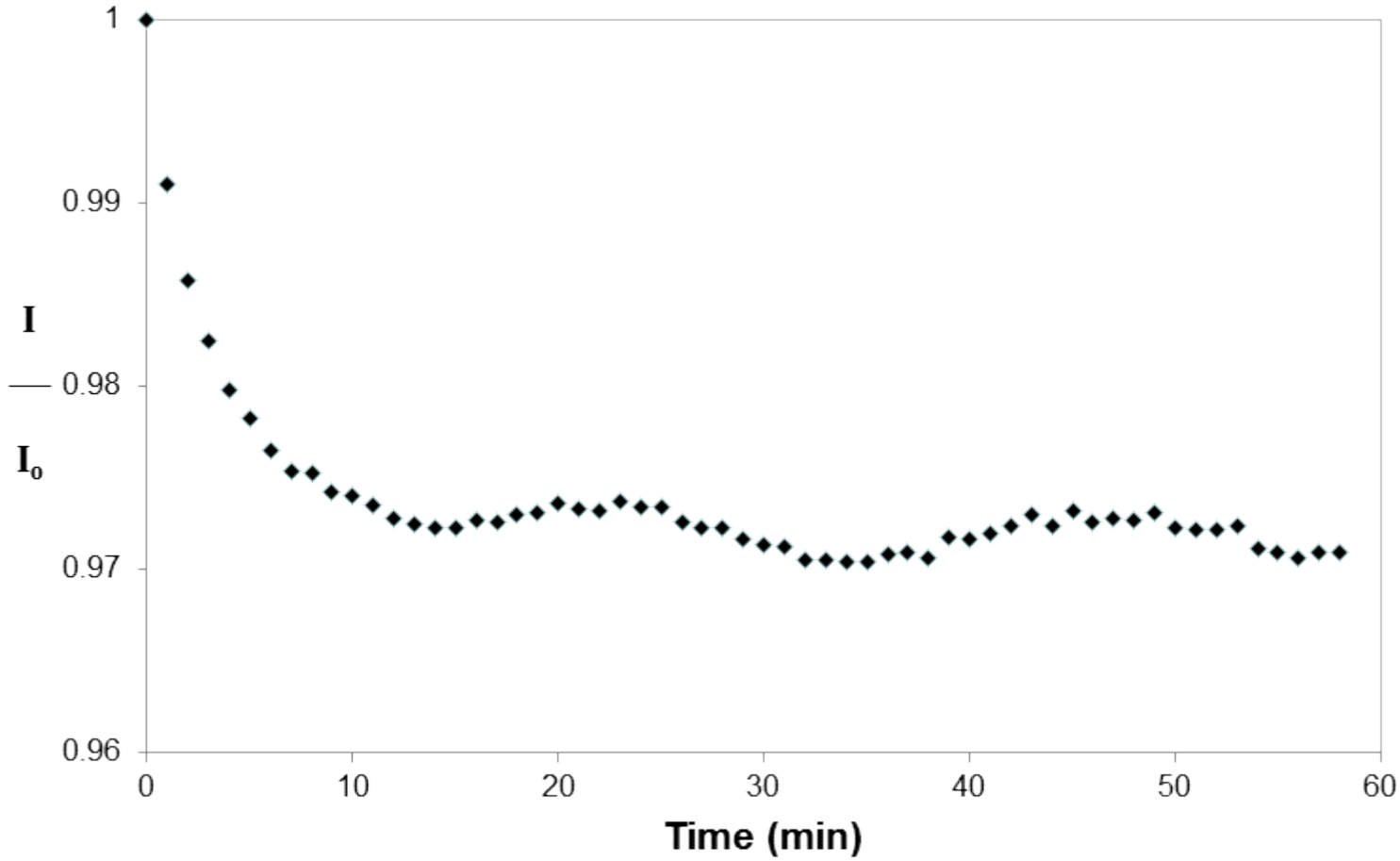
- Quantum dot fluorescence aging test
- Temperature characterization and repeatability
- Effect of quantum dot concentration and LED intensity variation

Low LED Intensity		Intermediate LED Intensity		High LED Intensity	
Low QD concentration	High QD concentration	Low QD concentration	High QD concentration	Low QD concentration	High QD concentration
T_1	T_1	T_1	T_1	T_1	T_1
T_2	T_2	T_2	T_2	T_2	T_2
T_3	T_3	T_3	T_3	T_3	T_3
T_4	T_4	T_4	T_4	T_4	T_4
T_5	T_5	T_5	T_5	T_5	T_5

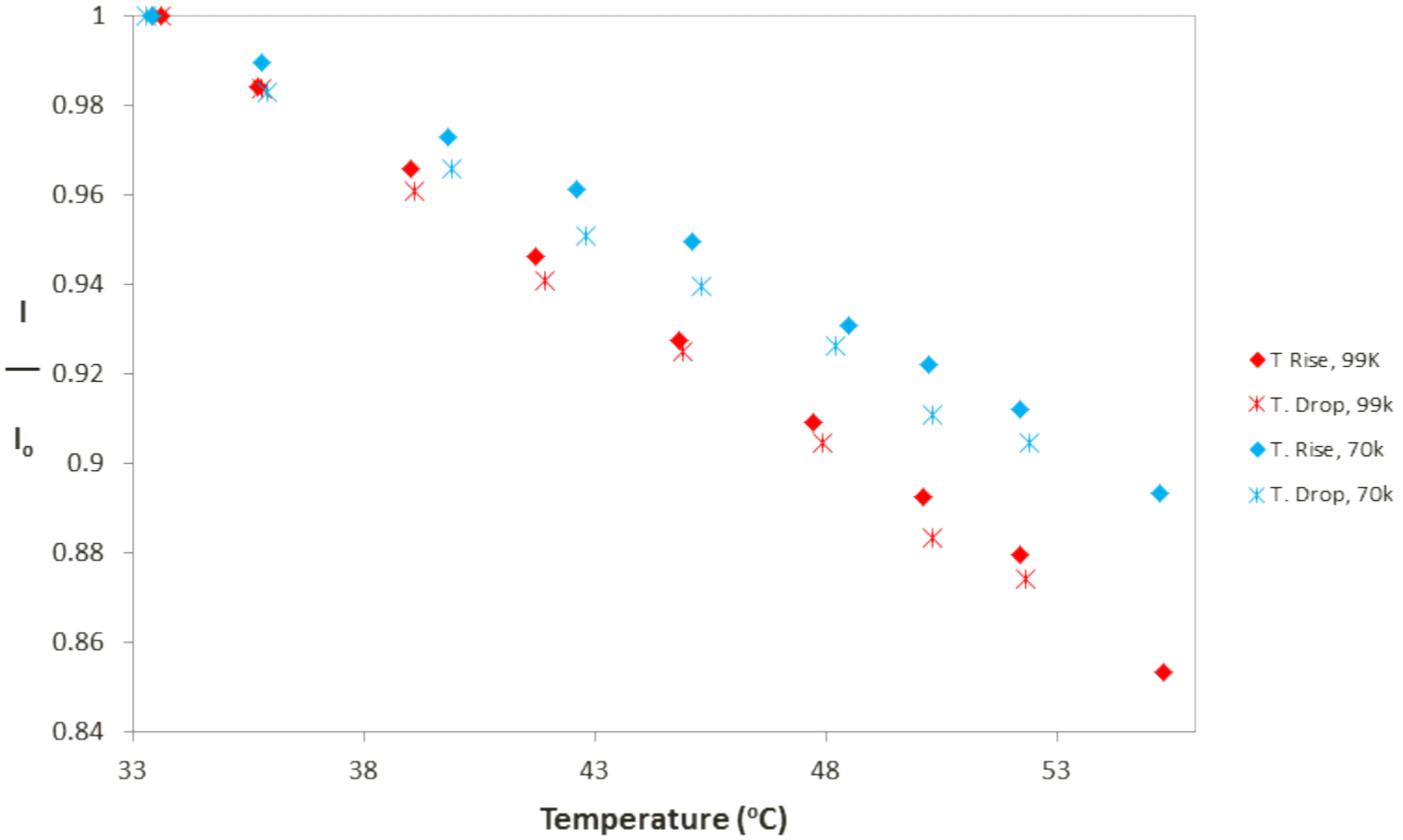
Test Apparatus



Aging Test

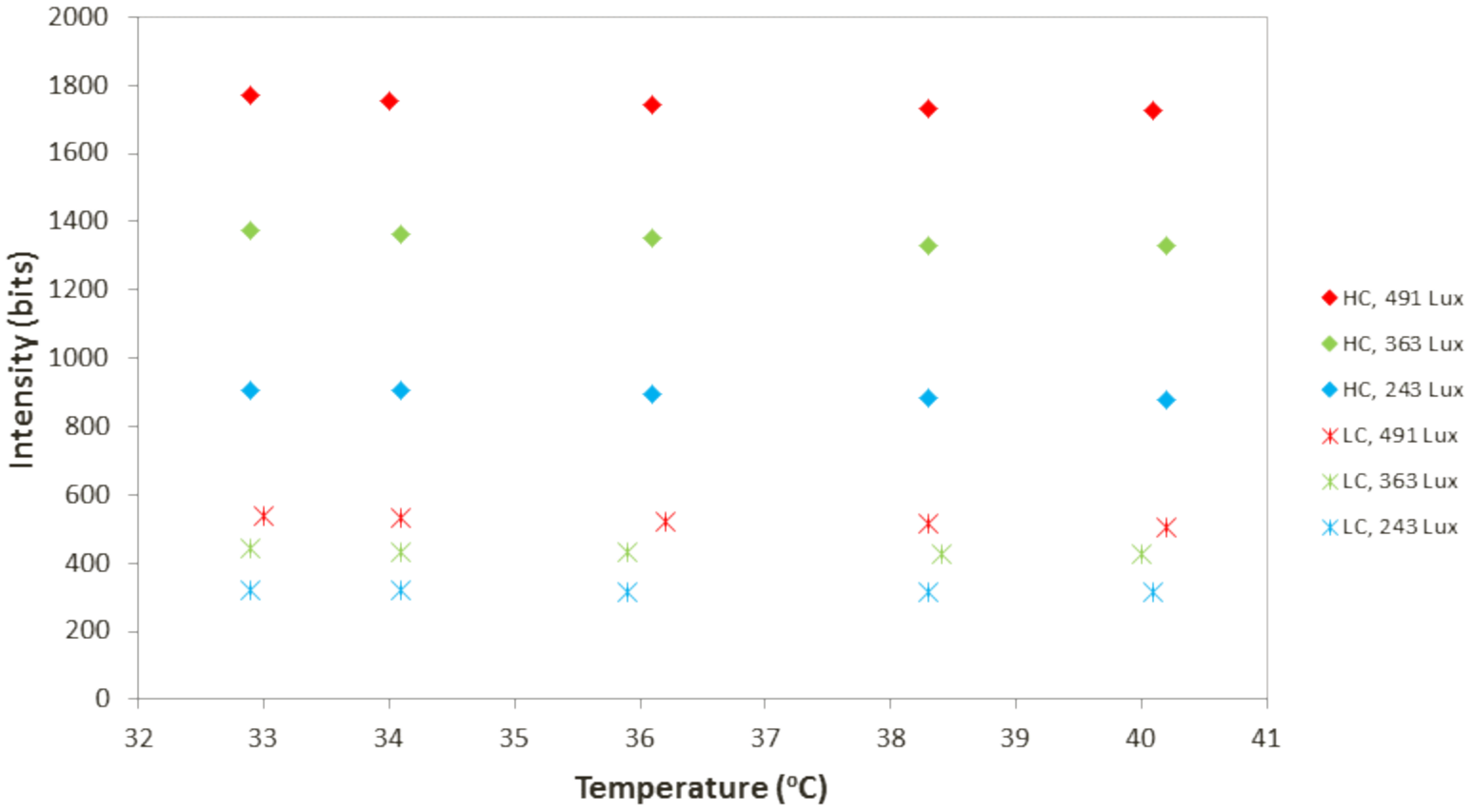


Temperature Characterization and Repeatability



99k and 70k are the exposure time of the camera in µs

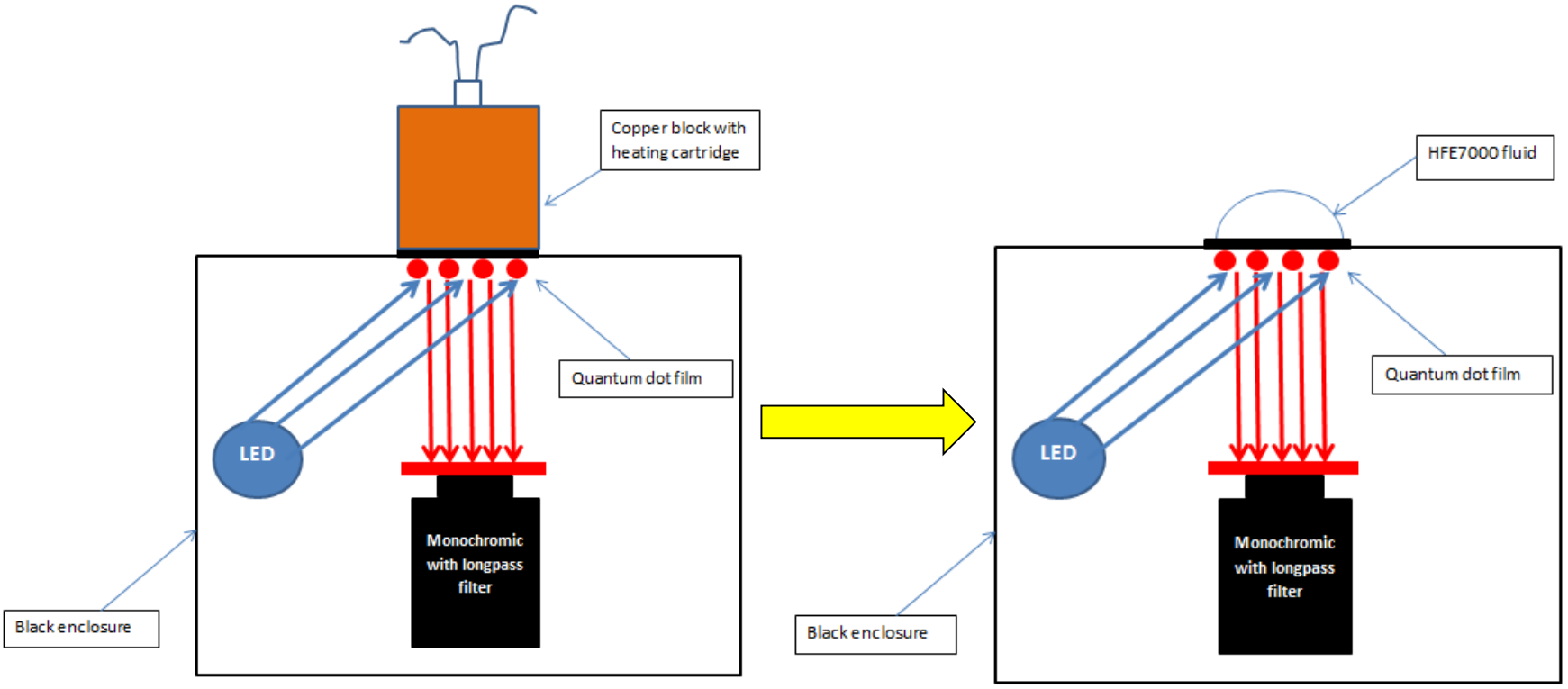
Effect of Quantum Dot Concentration and LED Intensity Variation



HFE7000 Demonstration Test Setup

Calibration

Droplet Testing



HFE7000 Surface Temperature Evolution

Summary

- Various parameters affecting quantum dots fluorescence were examined
  - Measurement steadiness
  - Sensitivity to temperature variation

- Usage of Quantum dots were examined in HFE7000 phase change applications

- A Novel technique for heat flux measurement in various heat transfer applications

References

- [1] Wikipedia
- [2] G. Bastida, F. Arregui, J. Goicoechea, and I. Matias, “Quantum Dots-Based Optical Fiber Temperature Sensors Fabricated by Layer-by-Layer,” IEEE Sensors Journal, vol. 6 , No. 6, December 2006.
- [3] Flexfire LEDs
- [4] Midopt

Acknowledgement

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