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About OMICS Group Conferences

OMICS Group International is a pioneer and leading science event organizer, which publishes around 400 open access journals and conducts over 300 Medical, Clinical, Engineering, Life Sciences, Pharma scientific conferences all over the globe annually with the support of more than 1000 scientific associations and 30,000 editorial board members and 3.5 million followers to its credit.

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UMassAmherst

Fabrication of an On-Sensor Microfluidic Device to Measure Sample Flow

Akshaya Shanmugam
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Biomedical Electronics Laboratory

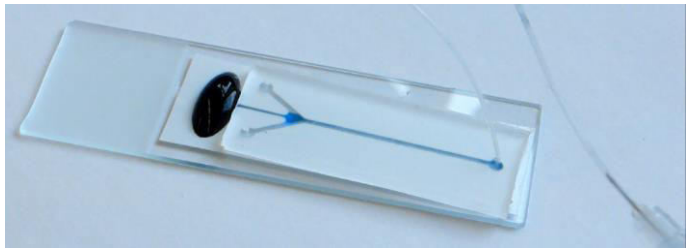
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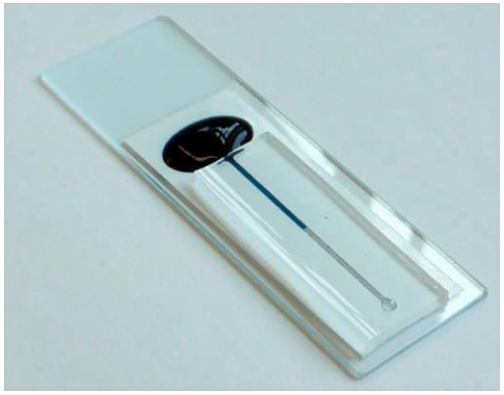
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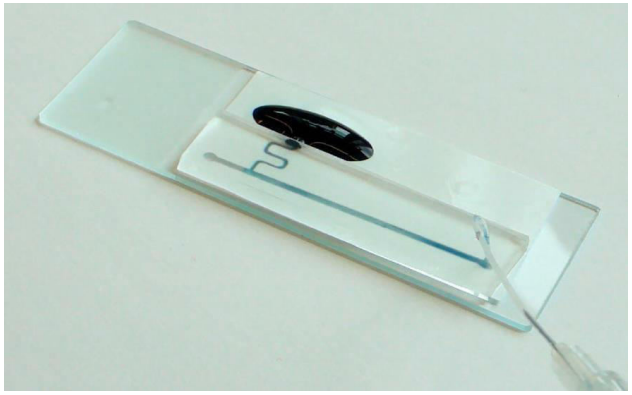
BACKGROUND

Conventional microfluidic devices

- Microfluidic devices
  - Small feature size
  - High sensitivity
  - Low cost

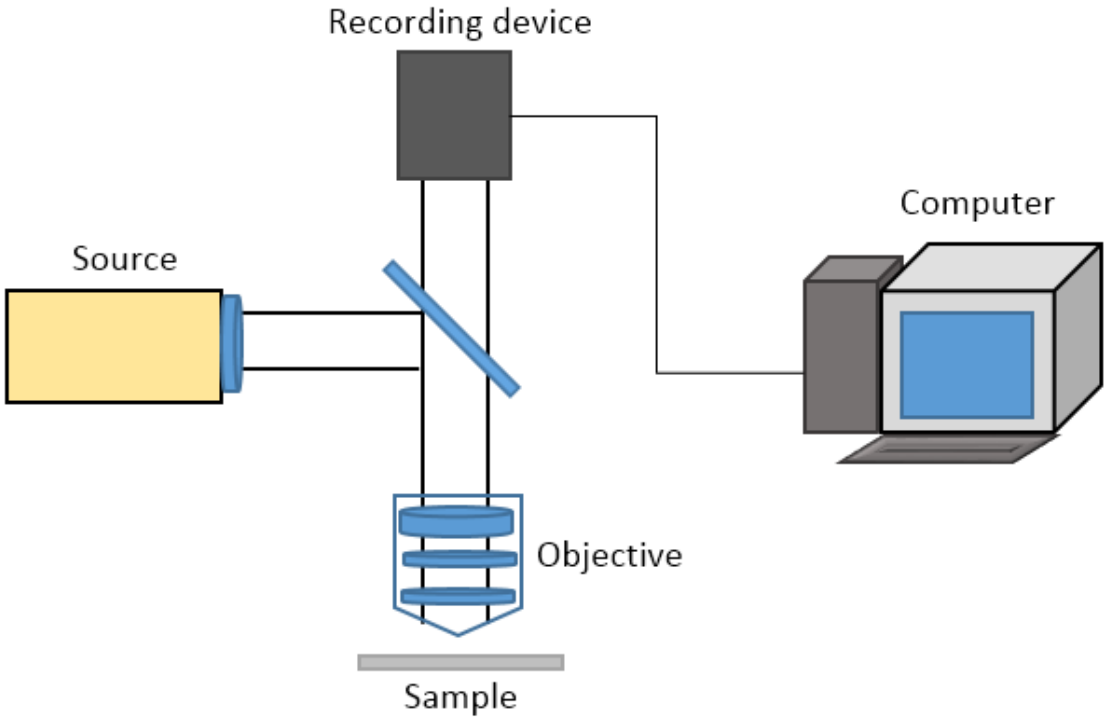






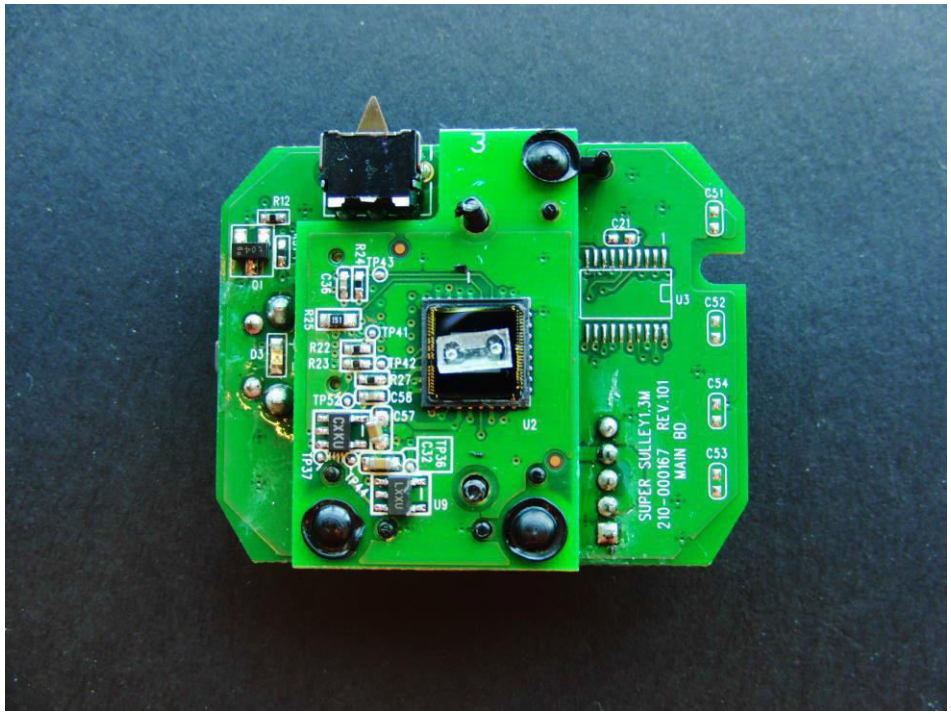
Conventional imaging setup

- Imaging setup for microfluidic devices
  - Non robust
  - Elaborate
  - Expensive



Proposed solution

- Fabrication of microfluidic devices on the imaging device



Polydimethylsiloxane

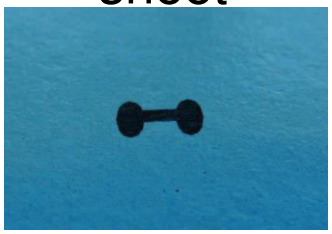
FABRICATION TECHNIQUE- PDMS

Conventional PDMS fabrication technique

- Chambers are formed using a master
- Cured PDMS channel is peeled off
- Channel is bonded to glass using a plasma bonder

Proposed PDMS fabrication technique

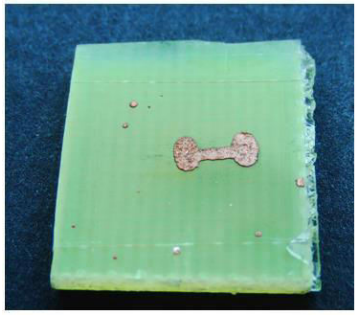
Print on toner sheet



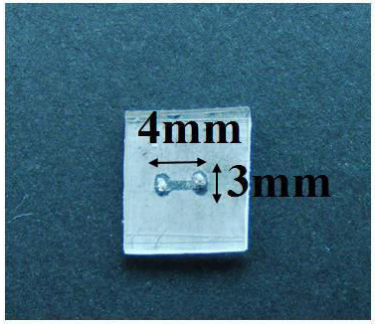
Pattern transfer



Etched board

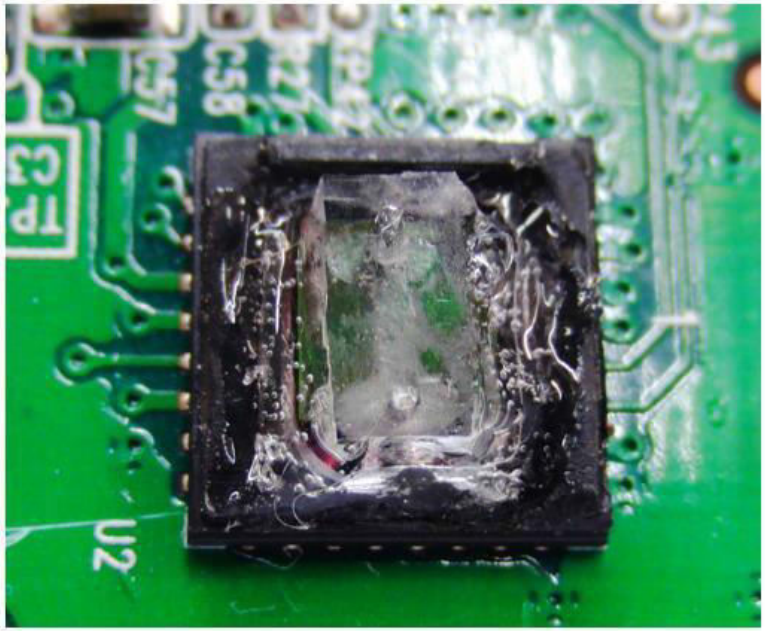


Cured PDMS



Proposed PDMS fabrication technique

- The cured slab of PDMS is placed on the sensor
- Bonded by dispensing small amounts of uncured PDMS around the chamber and flash cured



Pressure Sensitive Tape

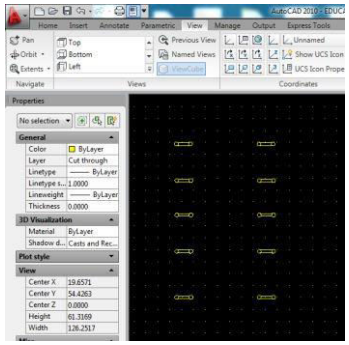
FABRICATION TECHNIQUE- PSA

Conventional PSA fabrication technique

- Tape is patterned
- Bonded to glass surface by applying pressure
- Device is sealed by placing acrylic glass on top of the channel

Proposed PSA fabrication technique

AutoDesk design



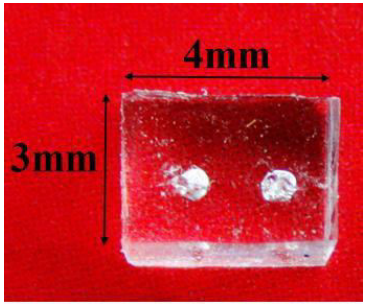
Patterned tape



Cleaning

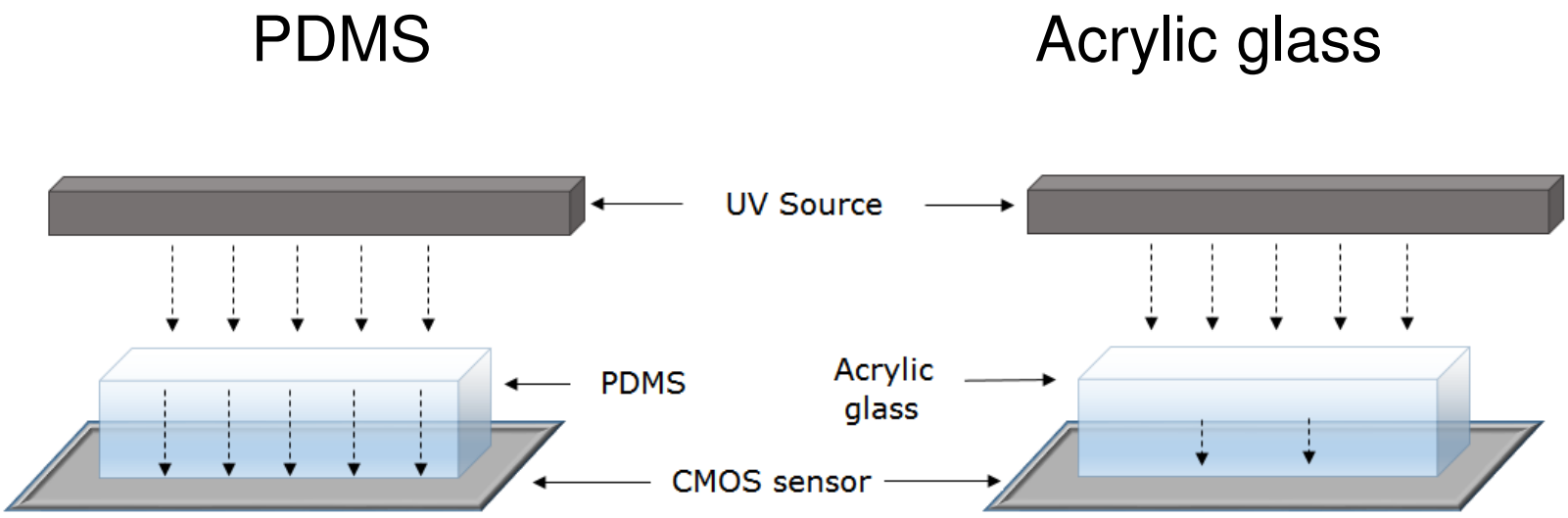


Top layer for chamber



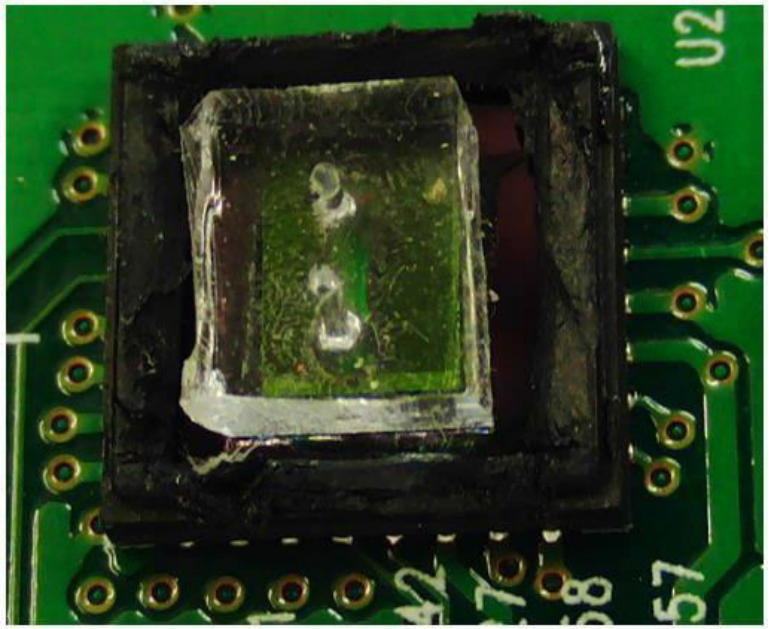
Proposed PSA fabrication technique

- PDMS is used as a top layer to seal the chamber
- Acrylic glass filters UV



Proposed PSA fabrication technique

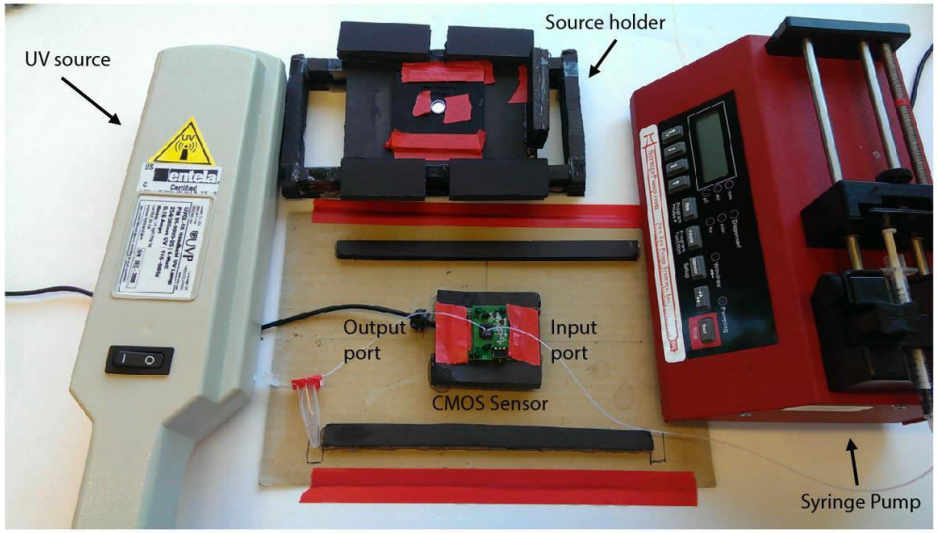
- The tape is stuck to the sensor
- PDMS slab is placed on the sensor
- Pressure is applied to seal the chamber



IMAGING SETUP

Complete imaging setup

- Tubing is inserted at the ports
- Sample is injected using a syringe pump
- Hand held UV source is used for fluorescence imaging



RESULTS

Image processing

- A video of the sample is recorded
- Matlab analyzes one frame at a time
- Movement of the sample across frame is recorded
- Basic image processing techniques are employed to collect this data



(A) Lensless Fluorescence Image



(B) Image After Thresholding



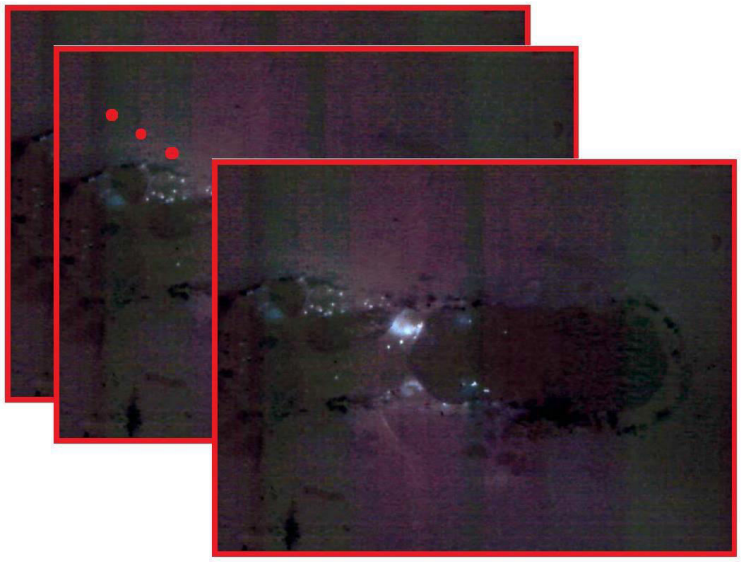
(C) Dilated Image



(D) Numbered Regions

Data from video

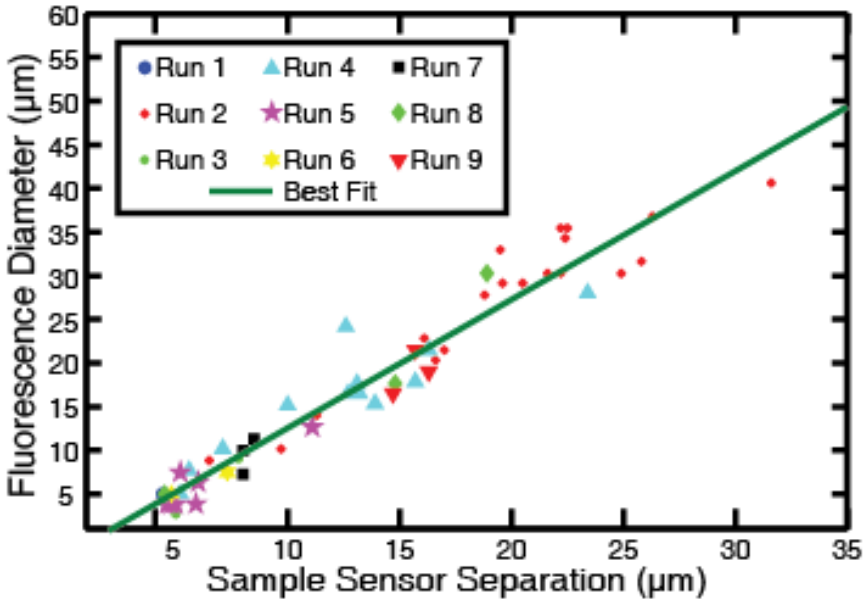
- The center coordinate points, fluorescence width, and height of every sample is recorded
- This information is collected from every frame in the video



X	Y	Width	Height	Frame
530	486	15.3	20.344	1
534	489	14.2	18.716	1
536	491	13.4	17.532	1
539	493	7.4	8.652	1
542	495	9.3	11.464	1

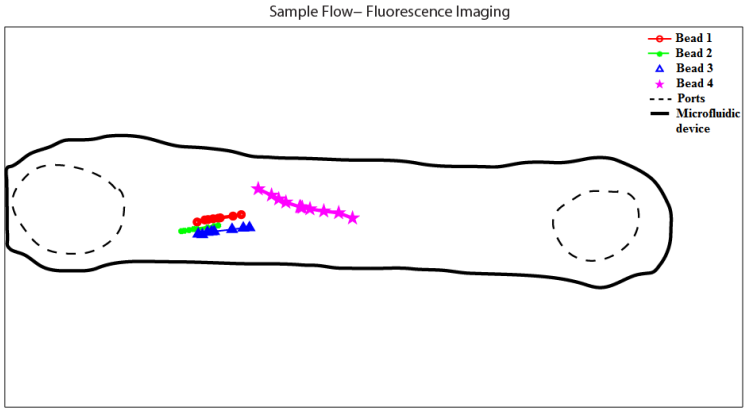
Height and fluorescence mapping

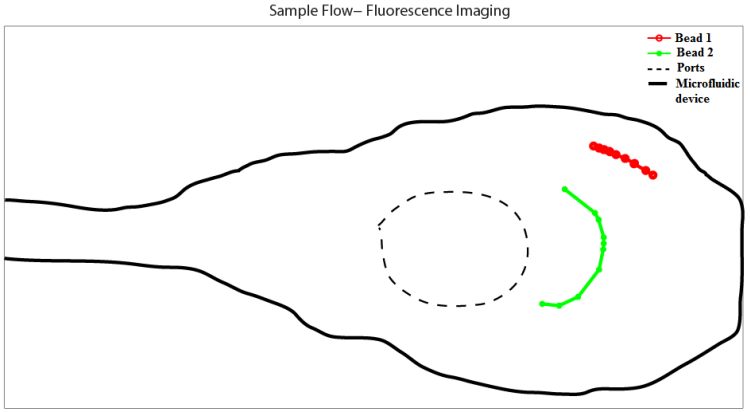
- Height information is obtained from a graph that maps the height of the sample and fluorescence signal width



Flow pattern

- The information is put together to determine the flow pattern





CONCLUSION

Applications

- Chemical sensors
- Flow cytometry
- Sample flow tracking
- Fluorescence detection

Acknowledgements

- Prof. Christopher Salthouse

  Electrical and Computer Engineering, UMass, Amherst

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  Food Science, UMass, Amherst

- Funding
  - Hluchyj fellowship
  - Eugene M. Isenberg Award

References

- C.D.Salthouse, A.Shanmugam, 'Lensless Fluorescence Imaging Systems to Measure Surface Sample Flow', 225th Electro Chemical Society Meeting, 2013
- A.Shanmugam, C.D.Salthouse, 'Lensless Fluorescence Imaging with Height Calculation', Journal of Biomedical Optics, 19(1):016002, 2013

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