Ultrahigh-speed videography of fiber fuse propagation: a tool for studying void formation

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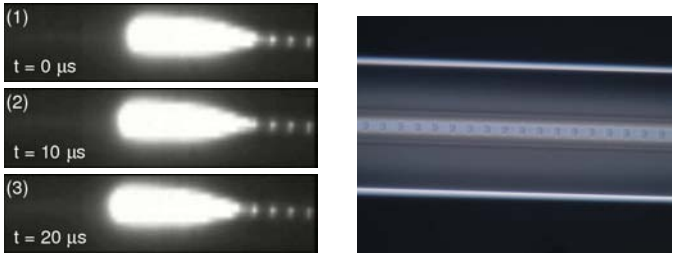

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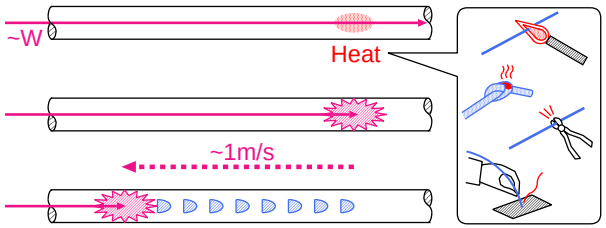
Introduction

Fiber fuse

- Found in 1987
  (R.Kashyap & K.J.Blow)
- Optical discharge runs toward the light source leaving periodic voids

Video



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OVERVIEW

Ultrahigh-speed videography of fiber fuse propagation

Videography

How was the fire-ball captured?

Front void

What is left behind at the fire-ball's position?

Archaeology археология · 考古学

What is told from the photos of left behind?

Slide 3

Videography

How was the fire-ball captured?

Setup

What is the trap like?

Movie

How its behavior changed with the pumping power?

Analysis

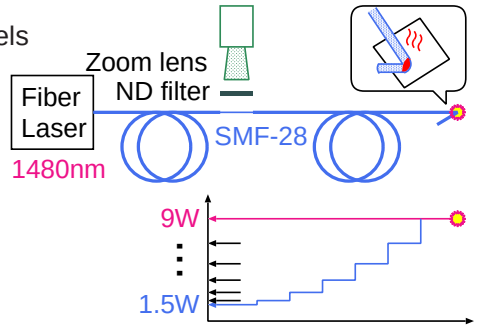
What is found out?

Slide 4

Setup

Shooting condition

- 4μs/frame
- 1μs-exposure with ND filters ($\times$16)
- 128$\times$16 pixels



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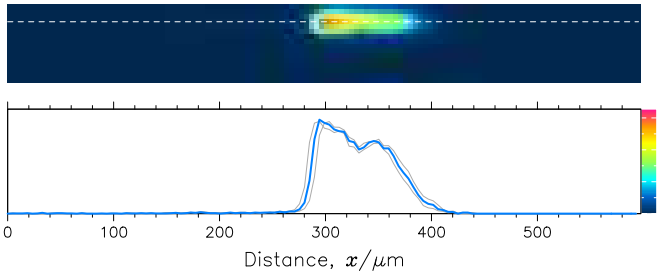
Movie

Movie 1



- 4μs/frame
- 1μs-exposure with ND filters ($\times$16)
- 128$\times$16 pixels

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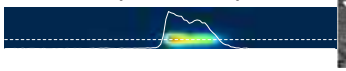
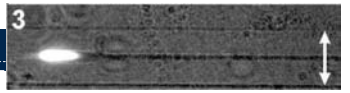
FYI

Current status of high-speed videography

Todoroki (ECOC 2004 PD)
Todoroki (LAT 2005)



Bufetov et al. (OFC 2005)



4μs/frame	Interval	128 or 70 μs/frame
1μs	Exposure	10μs
+ ND filters		+ black illumination
128$\times$16	Pixels	1024$\times$128

Movie 2

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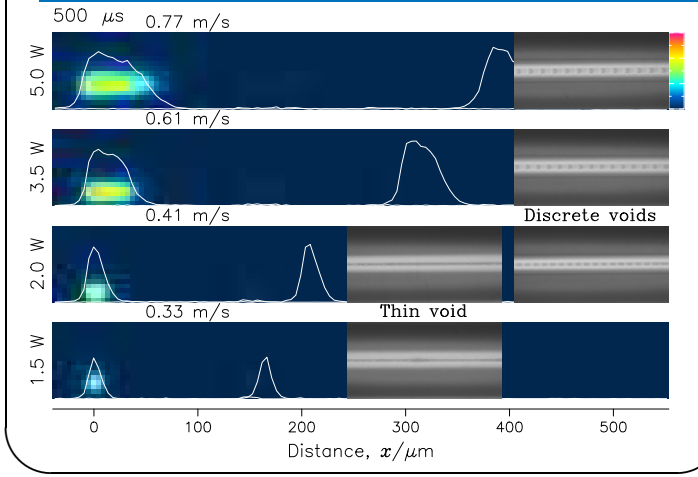
Analysis



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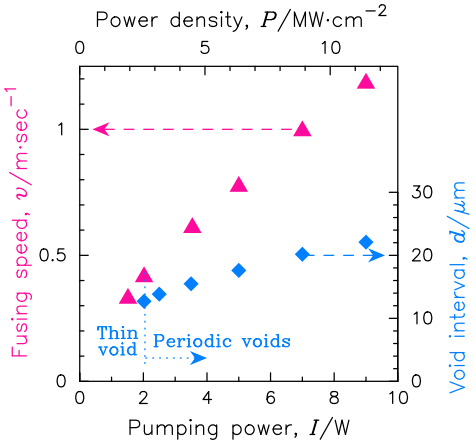
Analysis

Fusing speed & Void interval



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Videography

How was the fire-ball captured?

Setup

***1μs**-exposure & **x16** ND filters helped to catch it.*

Movie

*Pumping with >2W makes intensity profile **asymmetric**.*

Analysis

***Asymmetric** optical discharge leaves **periodic** voids.*

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Front void

What is left behind at the fire-ball's position?

Photography

*How **the samples** were prepared?*

Comparison

*What is related with **the asymmetry** of the discharge?*

Cavity size

*How it changes with increasing **the pumping power**?*

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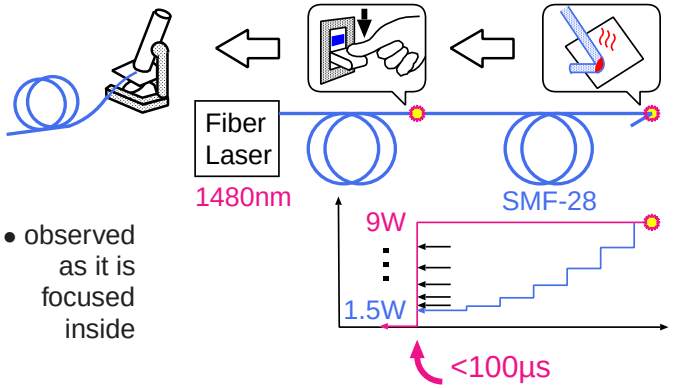
Photography

Sample preparation



- observed as it is focused inside

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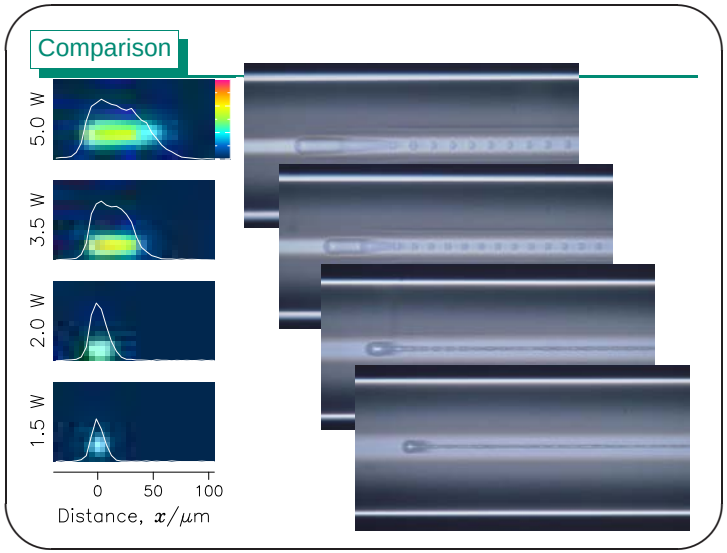

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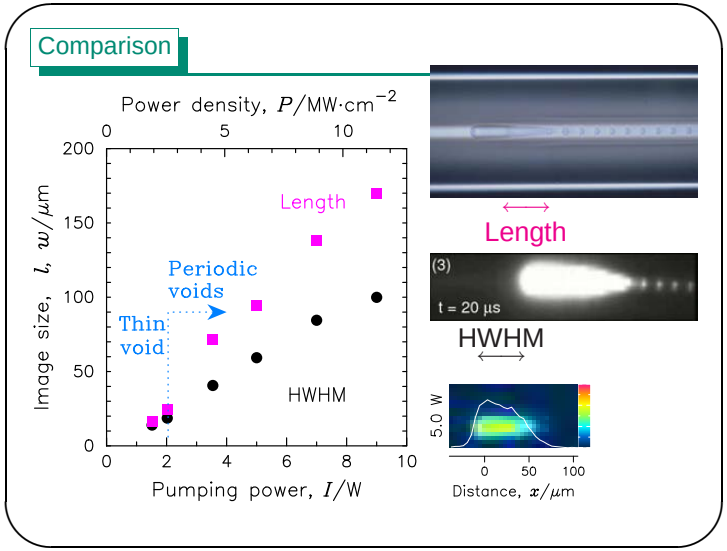

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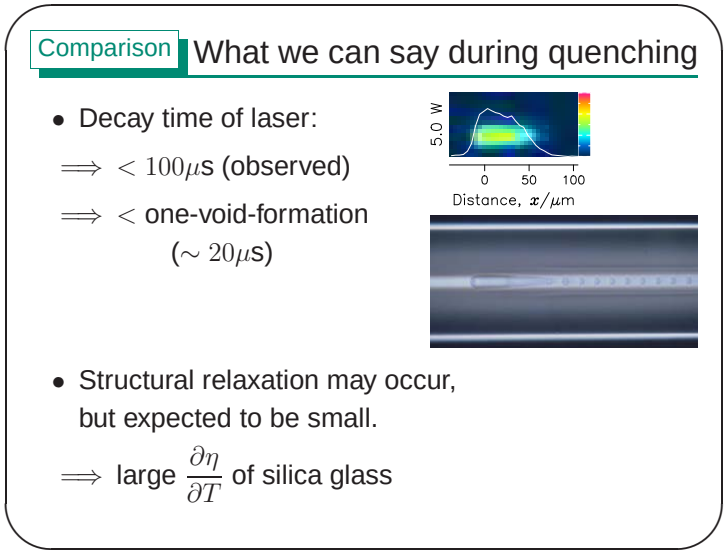

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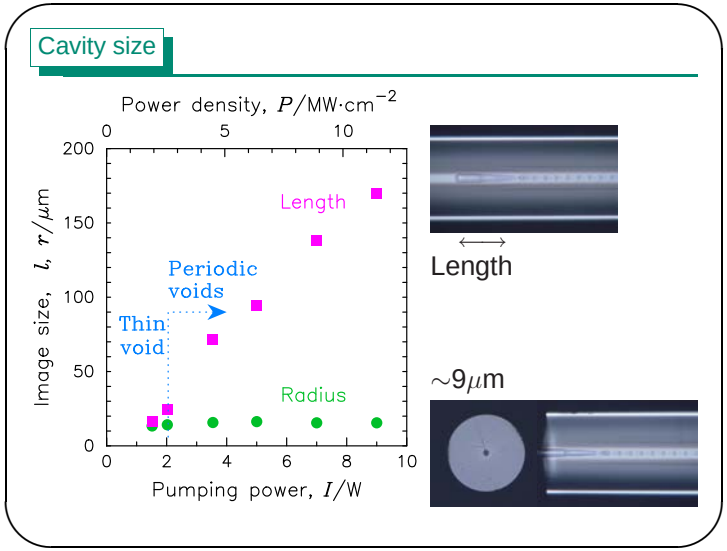

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Front void

What is left behind at the fire-ball's position?

Photography

*Prepared by **sudden power cut** after fiber-fusing.*

Comparison

*Asymmetric discharge leaves a **tailed** void.*

Cavity size

*Void radius is **constant** & independent of input power.*

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Archaeology

What is told from the photos of left behind?

Periodicity

*What comes into view considering **periodicity**?*

Reconstruction

*What is extracted from **a series of** photographs?*

Mechanism

*Why the regular voids look like **bullets**?*

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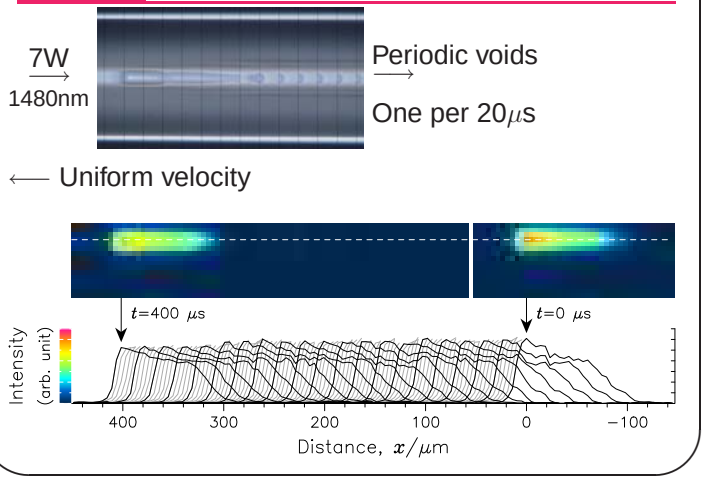
Periodicity



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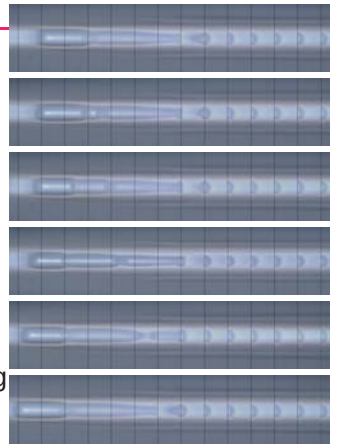
Reconstruction

- These are NOT in-situ
- but seem that the void casts off its tail ⟶ one of regular voids
- Assuming that each structure is sufficiently the same as that before quenching

Movie 3



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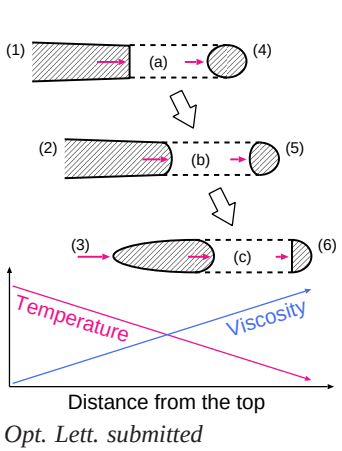
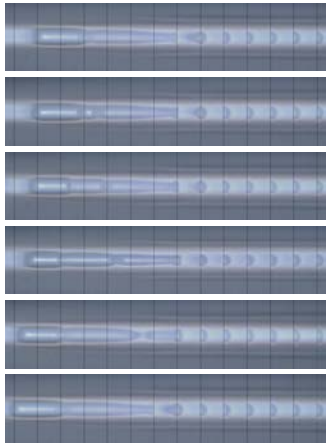
Mechanism

Formation of a bullet





Opt. Lett. submitted

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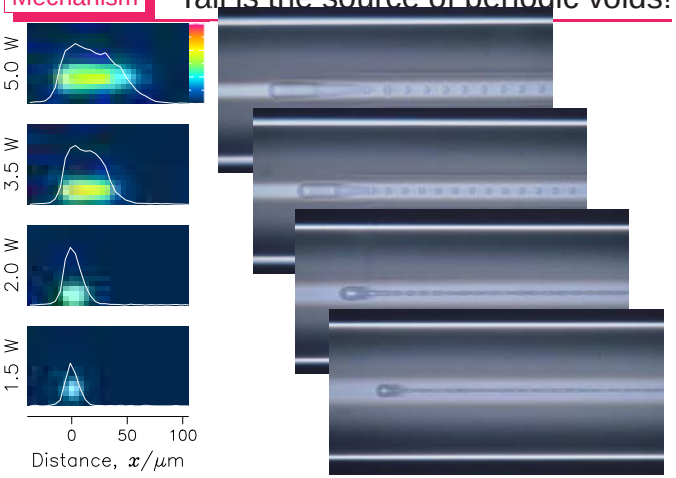
Mechanism

Tail is the source of periodic voids!



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Archaeology

What is told from the photos of left behind?

Periodicity

*Normalized position is the key for **sorting by time**.*

Reconstruction

*Extended **tail is casted off** to be one of regular voids.*

Mechanism

*Optical discharge **pushes casted tail** to make a bullet.*

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SUMMARY

Ultrahigh-speed videography of fiber fuse propagation

Videography

$>$2W-pump. $\Rightarrow$ asymmetric discharge & periodic voids

Front void

*Asymmetric discharge leaves a **tailed** void.*

Archaeology

*Extended **tail is casted off** to be one of periodic voids.*
*Optical discharge **pushes casted tail** to make a bullet.*

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Acknowledgement

- Mr. Kazuhide HANAKA, Mr. Akira SAKAMAKI

- Dr. Satoru INOUE

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