



Co-located Conferences

Photomask Technology and EUV Lithography **2018**

# CALL FOR PAPERS

Submit abstracts by 2 May 2018

**Conferences: 17-20 September 2018**  
**Exhibition: 18-19 September 2018**

Monterey Conference Center  
and Monterey Marriott  
Monterey, California, USA

[www.spie.org/PUV18call](http://www.spie.org/PUV18call)



## Present your work in Monterey

SPIE Photomask Technology + Extreme Ultraviolet Lithography, a technical meeting for mask makers, EUV Lithography, emerging mask technologies, and the future of mask business.

### Technologies

- Photomasks
- Patterning
- Metrology
- Inspection/repair
- Mask business
- EUV Lithography
- Emerging technologies

Submit abstracts by 2 May 2018



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# Plan to Participate.

We are pleased SPIE Photomask Technology and the International Conference on Extreme Ultraviolet Lithography will again be co-located in Monterey, California at the newly renovated Monterey Conference Center.

## SPIE PHOTOMASK TECHNOLOGY

The 38th Photomask Conference organized by SPIE in cooperation with BACUS Technical Group, is the global forum for scientists, engineers, and industry leaders to present and discuss key topics related to photomasks. The conference addresses design, fabrication, quality control, and the use of photomasks in the semiconductor industry.

As Conference Chairs, we urge you to participate in our 38th year by submitting your abstract(s), and to encourage your colleagues to do the same. Also encourage your company to continue their support for the Photomask Technology symposium. We hope to see you in Monterey.



### Emily E. Gallagher

imec (Belgium)  
2018 Photomask Technology  
Conference Chair



### Jed H. Rankin

GLOBALFOUNDRIES Inc. (USA)  
2018 Photomask Technology  
Conference Co-Chair

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## INTERNATIONAL CONFERENCE ON EXTREME ULTRAVIOLET LITHOGRAPHY

The International Conference on Extreme Ultraviolet Lithography provides a forum to discuss and assess the worldwide status of EUV technology and infrastructure readiness. Scientists, engineers, and industry leaders meet to present and discuss new and unpublished materials.

As Conference Chairs, we urge you to participate by submitting your abstract(s), and to encourage your colleagues to do the same. Also encourage your company to continue their support for the Extreme Ultraviolet Lithography conference.



### Kurt G. Ronse

imec (Belgium)  
2018 EUV Lithography  
Conference Chair



### Eric Hendrickx

imec (Belgium)  
2018 EUV Lithography  
Conference Co-Chair



### Patrick P. Naulleau

Lawrence Berkeley National Lab. (United States)  
2018 EUV Lithography  
Conference Co-Chair



### Paolo A. Gargini

Stanford Univ. (United States)  
2018 EUV Lithography  
Conference Co-Chair



### Toshiro Itani

EUVL Infrastructure Development Ctr., Inc. (Japan)  
2018 EUV Lithography  
Conference Co-Chair

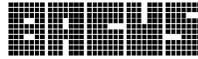
# Photomask Technology (PM18)

Conference Chair: **Emily E. Gallagher**, imec (Belgium)

Conference Co-Chair: **Jed H. Rankin**, GLOBALFOUNDRIES Inc. (United States)

Program Committee: **Frank E. Abboud**, Intel Corp. (United States); **Uwe F.W. Behringer**, UBC Microelectronics (Germany); **Byungcheol (Brian) Cha**, SAMSUNG Electronics Co., Ltd. (Korea, Republic of); **Lucien Bouchard**, Photronics, Inc.; **Thomas B. Faure**, GLOBALFOUNDRIES Inc. (United States); **Aki Fujimura**, D2S, Inc. (United States); **Brian J. Grenon**, RAVE LLC (United States); **Naoya Hayashi**, Dai Nippon Printing Co., Ltd (Japan); **Izak Kapilevich**, Applied Materials, Inc. (United States); **Bryan S. Kasprowicz**, Photronics, Inc. (United States); **Byung Gook Kim**, SAMSUNG Electronics Co., Ltd. (Korea, Republic of); **Lloyd C. Litt**, GLOBALFOUNDRIES Inc. (United States); **Paul A. Morgan**, Micron Technology, Inc. (United States); **Kent H. Nakagawa**, Toppan Photomasks, Inc. (United States); **Takahiro Onoue**, HOYA Corp. (Japan); **Jan Hendrik Peters**, BMBG Consult (Germany); **Moshe E. Preil**, KLA-Tencor Corp. (United States); **Douglas J. Resnick**, Canon Nanotechnologies, Inc. (United States); **Thomas Scherübl**, Carl Zeiss SMT GmbH (Germany); **Yuyang Sun**, Mentor Graphics Corp. (United States); **Bala Thumma**, Synopsys, Inc. (United States); **Banqiu Wu**, Applied Materials, Inc. (United States); **Shusuke Yoshitake**, NuFlare Technology, Inc. (Japan)

Co-Sponsored by:



SPIE Photomask Technology is a global forum for scientists, engineers, and industry leaders to present and discuss key topics related to photomasks. The conference addresses design, fabrication, quality control, and the use of photomasks in the semiconductor industry. EUV lithography is being driven toward HVM manufacturing, 193nm lithography tolerances are increasingly tight to enable multiple patterning solutions, and it is imperative to enhance productivity in both mask manufacturing excellence and mask integration in the wafer fab. At the same time, nanoimprint remains a technology of interest and research continues to develop new mask materials, inspection methods and high-NA EUV lithography. The photomask is increasingly recognized as a key enabler for lithographic solutions, or a potential detractor. This landscape brings together mask makers, chip manufacturers, design automation companies, tool manufacturers, and the academic and national research organizations. Information will be shared through the structured conference oral and poster sessions and the exhibition, but also informally through networking opportunities throughout the conference.

Papers that address all aspects of photomasks research, development manufacturing and use are solicited. This means that topics related to nanoimprint lithography, inverse lithography, high-NA, EUV, multi-patterning and established DUV are all of interest.

Probable sessions include:

- Design automation and data prep (DFM, OPC, SMO)
- Mask process flow, cost of ownership
- Mask write, corrections, process compensation (MPC)
- Mask blanks and metrology (materials, process, control)
- Mask process (resist, etch, cleans, ...)
- Metrology (CD, placement, other)
- Defects: blank and mask, inspection, repair, verification
- Defect control: strategies, pellicles, data management
- Simulation and imaging: mask transfer to wafer (LER, SWA, surface roughness)
- Lifetime, defectivity, verification and use in the wafer fab.

Joint sessions will be organized with EUVL18 on topics related to EUV masks.

As Conference Chairs, we urge you to participate in our 38th year by submitting your abstract(s), and to encourage your colleagues to do the same. Also encourage your company to continue their support for the Photomask Technology symposium.

**2018 PHOTOMASK BEST STUDENT PAPER AWARD**

*For more information see page 9.*

# International Conference on Extreme Ultraviolet Lithography 2018 (EUVL18)

*Conference Chairs:* **Kurt G. Ronse**, imec (Belgium); **Patrick P. Naulleau**, Lawrence Berkeley National Lab. (United States); **Paolo A. Gargini**, Stanford Univ. (United States); **Toshiro Itani**, EUVL Infrastructure Development Ctr., Inc. (Japan)

*Program Committee:* **Eric Hendrickx**, imec (Belgium); **Eric M. Panning**, Intel Corp. (United States), **Winfried Kaiser**, Carl Zeiss SMT GmbH (Germany), **Satoshi Tanaka**, EUVL Infrastructure Development Ctr., Inc. (Japan)

Co-Sponsored by:



The International Conference on Extreme Ultraviolet Lithography provides a forum to discuss and assess the worldwide status of EUV technology and infrastructure readiness. Scientists, engineers, and industry leaders meet to present and discuss new and unpublished materials. They address the main challenges associated with the upcoming industrialization of EUV Lithography and the further extendibility of the technology to smaller dimensions. The 2017 EUV Symposium highlighted the progress and confidence towards the insertion of EUV lithography in manufacturing, but at the same time also risks for extending of the technology became clear -- which requires further development of materials, smoothing techniques, photomask control, and characterization, scanner imaging optimization, and EUV light source power to secure a yielding process. At the same time, the extendibility of EUV using High-NA is becoming more feasible, and will require further infrastructure development on the above mentioned items.

Papers that address all aspects of EUV lithography are solicited. There is interest in reviewing technologies that are close to manufacturing, but also for papers that address new and exploratory concepts in EUV.

- EUV readiness and insertion in manufacturing (EI)
- EUV tools, including sources and optics (ET)
- EUV mask metrology, inspection and lifetime (MA)
- EUV mask and imaging (IM)
- EUV mask pellicles (PE)
- EUV resist materials/process and contamination (RE)
- EUV patterning and process enhancement (EP)
- EUV lithography extendibility (EE)
- EUV readiness and insertion in manufacturing (EI)
- EUV tools, including sources and optics (ET).

Joint sessions will be organized with SPIE Photomask for the EUV mask related topics. At the same time, the program chairs will actively solicit speakers and presentations in key areas of EUV development that are not mask related, such as novel EUV materials.

## Save the date

Abstracts Due: **2 May 2018**

Author Notification: **25 June 2018**

Manuscript Due Date: **22 August 2018**

Please Note: Submissions imply the intent of at least one author to register, attend the conference, present the paper as scheduled, and submit a full-length manuscript for publication in the conference proceedings.

Submit your abstract today: [www.spie.org/puv18call](http://www.spie.org/puv18call)

## AWARDS GIVEN IN 2017

### 2017 BACUS Lifetime Achievement Award

Dr. Hiroaki Morimoto, Meister, Senior Chief Researcher, Business Development & Research Division, Toppan Printing Co., Ltd. (Japan)

For his contributions to photomask technology in the areas of attenuated phase shift masks, ion beam mask repair, and mask technology development consortia.



### 2017 BACUS Prize

*Two individuals that received this award.*

**Dr. Hans Loeschner**, Co-Founder, and Chief Scientific Officer, IMS Nanofabrication AG (Austria)

In recognition of his contribution to the photomask industry through his work and influence to develop and commercialize high keV Multi-Beam photomask lithography tools.

and

**Dr. Elmar Platzgummer**, IMS Nanofabrication AG (Austria)

In recognition of his contribution to the photomask industry through his work and influence to develop and commercialize high keV Multi-Beam photomask lithography tools.



### 2017 Photomask/BACUS Best Posters

*1<sup>ST</sup> PLACE BEST POSTER*

**Transparent and conductive backside coating of EUV lithography masks for ultra- short pulse laser correction**, Rinu A. Maniyara, Dhriti S. Ghosh, Valerio Pruneri, ICFO - Institut de Ciències Fotòniques (Spain) [10451-66]

*2<sup>ND</sup> PLACE BEST POSTER*

**Laser-scan lithography and electrolytic etching for fabricating mesh structures on stainless-steel pipes 100mm in diameter**, Hiroshi Takahashi, Toshiyuki Horiuchi, Tokyo Denki Univ. (Japan) [10451-55]

*3<sup>RD</sup> PLACE BEST POSTER*

**The deposition of the Cr binary film and attenuated phase-shift film on the FPD photomask substrate**, Takashi Yagami, Yohei Takarada, Kento Hayashi, Takashi Ozawa, Nikon Corp. (Japan) [10451-54]

### 2017 Annual Photonics Best Student Paper Awards

*1<sup>ST</sup> PLACE*

**Actinic EUV scatterometry for parametric mask quantification**, Stuart Sherwin, Univ. of California, Berkeley (United States)(Student Author), Andrew R. Neureuther, Univ. of California, Berkeley (United States); Patrick P. Naulleau, Lawrence Berkeley National Lab. (United States) [10450-27]

*FINALISTS*

**Enhanced critical feature representation for fuzzy-matching for lithography hotspot detection**, Mohamed M. Elshabrawy, Cairo Univ. (Egypt), Mentor Graphics Egypt (Egypt); (Student Author); Amr G. Wassal, Cairo Univ. (Egypt), Si-Ware (Egypt) [10451-37]

**EUV mask roughness can recover litho-tool aberrations**, Aamod Shanker, Univ. of California, Berkeley (United States)(Student Author), Laura Waller, Univ. of California, Berkeley (United States); Antoine Wojdyla, Markus P. Benk, Kenneth A. Goldberg, Patrick P. Naulleau, Lawrence Berkeley National Lab. (United States) [10450-28]

**Evaluating mechanical characteristic of SiNx EUV pellicle membrane**, Yong Ju Jang, Hanyang Univ. (Korea, Republic of) (Student Author), Jung Hwan Kim, Jin-ho Ahn, Hanyang Univ. (Korea, Republic of) [10450-29]

*Awards Sponsored by:*



## 2017 Zeiss Best Student Poster Awards

### 1<sup>ST</sup> PLACE

**Thermo-mechanical distortion caused by particle defect on extreme ultraviolet pellicle**, Jae-Hun Park, Hanyang Univ. (Korea, Republic of) (Student Author), Eun-Sang Park, Sung-Gyu Lee, Hye-Keun Oh, Hanyang Univ. (Korea, Republic of) [10450-63]



### 2<sup>ND</sup> PLACE

**Optimized phase-shifting masks for high-resolution resist patterning by interference lithography**, Sascha Brose, RWTH Aachen Univ. (Germany) (Student Author), Serhiy Danylyuk, Lukas Bahrenberg, RWTH Aachen Univ. (Germany); Rainer Lebert, RI Research Instruments GmbH (Germany); Peter Loosen, RWTH Aachen Univ. (Germany); Larissa Juschkina, JARA-Fundamentals of Future Information Technology (Germany) [10450-81]



### 3<sup>RD</sup> PLACE

**Thermo-mechanical behavior analysis of extreme-ultraviolet pellicle cooling with H2 flow**, Myung-Gi Kang, Hanyang Univ. (Korea, Republic of) (Student Author); Sung-Gyu Lee, Eun-Sang, Park, Hye-Keun Oh, Hanyang Univ. (Korea, Republic of) [10450-59]



Award Sponsored by:



## 2018 Best Student Poster Award generously sponsored by ZEISS

The ZEISS Award for Talents in the Industry was established to support students working in the fields of photomask and EUV lithography.

### To be considered:

- The Student must be the presenting author of the poster. They must attend the conference and be present at their poster during the poster session.
- The student must identify themselves as a student during the abstract submission.
- The Student must be the lead manuscript author and submit their manuscript by 22 August 2018.

The SPIE Photomask + EUV Lithography symposium student posters will be assessed by an award committee consisting of members of the program committee from both conferences. Contributions will be judged for technical merit of the poster, relevance of the topic to the industry and the author's ability to explain the work. Winners will be awarded a ZEISS certificate, a trophy, and a monetary prize: \$1000 for 1st place, \$500 each for 2nd and 3rd places.

Awards Sponsored by



*By submitting an abstract, I agree to the following conditions:*

## AN AUTHOR OR COAUTHOR (INCLUDING KEYNOTE, INVITED, ORAL, AND POSTER PRESENTERS) WILL:

- Register at the reduced author registration rate (current SPIE Members receive an additional discount on the registration fee).
- Attend the meeting.
- Make the presentation as scheduled in the program.
- Submit a manuscript (6 pages minimum) for publication in the SPIE Digital Library.

### For EUV Lithography authors only: Convert your PPT to PDF (or Word)

- File – Print – 2 Slides per page – print as PDF
- US Letter Size
- 2 slides per page

- Obtain funding for registration fees, travel, and accommodations, independent of SPIE, through their sponsoring organizations.
- Ensure that all clearances, including government and company clearance, have been obtained to present and publish. If you are a DoD contractor in the USA, allow at least 60 days for clearance.

Submit an abstract and summary online at :

[www.spie.org/puvcall](http://www.spie.org/puvcall)

- Abstracts should contain enough detail to clearly convey the approach and the results of the research. Accepted abstracts will be published and made available at the meeting. Please submit a **500-word abstract** for review.
- Please also submit a **100-word text summary** suitable for early release. If accepted, this summary text will be published prior to the meeting in the online or printed programs promoting the conference.
- To provide the research community with enhanced access to information presented at SPIE conferences. SPIE will record the audio plus screen content of oral presentations and, with author permission only, will publish the recordings on the SPIE Digital Library. When submitting an abstract, you will be asked to respond to the permission request.
- Only original material should be submitted.
- Abstracts should contain enough detail to clearly convey the approach and the results of the research.

- Commercial papers, papers with no new research/development content, and papers where supporting data or a technical description cannot be given for proprietary reasons will not be accepted for presentation in this conference.
- Please do not submit the same, or similar, abstracts to multiple conferences.

## REVIEW, NOTIFICATION, AND PROGRAM PLACEMENT INFORMATION

- To ensure a high-quality conference, all submissions will be assessed by the Conference Chair/Editor for technical merit and suitability of content.
- Conference Chair/Editors reserve the right to reject for presentation any paper that does not meet content or presentation expectations.
- The contact author will receive notification of acceptance and presentation details by e-mail no later than: **25 June 2018**.
- Final placement in an oral or poster session is subject to the Chairs' discretion.

## PROCEEDINGS OF SPIE AND SPIE DIGITAL LIBRARY INFORMATION

- Manuscript instructions are available from the **"For Authors/Presenters"** link on the conference website.
- Conference Chair/Editors may require manuscript revision before approving publication and reserve the right to reject for publication any paper that does not meet acceptable standards for a scientific publication. Conference Chair/Editors' decisions on whether to allow publication of a manuscript is final.
- Authors must be authorized to transfer copyright of the manuscript to SPIE, or provide a suitable publication license.
- Only papers presented at the conference and received according to publication guidelines and timelines will be published in the conference Proceedings of SPIE and SPIE Digital Library.
- Published papers are indexed in leading scientific databases including Astrophysical Data System (ADS), Chemical Abstracts (relevant content), Compendex, CrossRef, Current Contents, DeepDyve, Google Scholar, Inspec, Portico, Scopus, SPIN, and Web of Science Conference Proceedings Citation Index, and are searchable in the SPIE Digital Library. Full manuscripts are available to SPIE Digital Library subscribers worldwide.

Find full information online: [www.spie.org/puv18call](http://www.spie.org/puv18call)

Full program, housing, travel, and registration information will be online in June 2018.

### Hotel

SPIE will arrange discounted rates at the Monterey Marriott. Housing will open for reservations by June 2018

### Exhibit

Learn more about exhibiting and sponsoring by visiting the "For Exhibitors" section of the website, or call SPIE Sales at +1 360 676 3290





## Gain visibility at the meeting for mask makers, EUV Lithography, and emerging technologies

Join us in Monterey to share your developments and make valuable connections. Whether you are presenting to your peers or are looking to gain further knowledge to enhance your research area, we welcome your participation.

**JOIN US FOR SPIE  
PHOTOMASK TECHNOLOGY +  
EUV LITHOGRAPHY IN MONTEREY.**



*“Was excellent this year to have the Photomask and EUV joint conference.”*

**—2017 Technical Attendee**

## Announcing the 2018 Photonics Best Student Paper Award



Photonics Inc. has generously offered to sponsor a Best Student Paper Award at the SPIE Photomask Technology and EUV Lithography 2018 in Monterey, California. There will be 4 finalists with each receiving a monetary award. The winner will be chosen from the finalists and be awarded during the festivities on Wednesday evening 19 September 2018.

In order to be considered for these awards:

- Presenter must make their presentation as scheduled, oral only
- Manuscript must be submitted to SPIE no later than the week of **22 August 2018**.

**STUDENTS:** In addition to the above requirements, to be considered for the Best Student Paper Award:

- Student must be the presenting author at the conference
- Student must be the leading author of the manuscript
- Student must send a message to the conference chairs identifying themselves as a student. This should be done after you have submitted your abstract, and must include your Tracking Number and paper title. You must also include a 2-page extended abstract with your message.

Please send to: **Bryan S. Kasprowicz** at [bkasprowicz@photonics.com](mailto:bkasprowicz@photonics.com) and **Emily E. Gallagher** at [Emily.gallagher@imec.be](mailto:Emily.gallagher@imec.be) and **Jed H. Rankin** at [Jed.rankin@globalfoundries.com](mailto:Jed.rankin@globalfoundries.com)

A team of experts headed by the PUV18 conference chairs will evaluate all the papers, both for quality and content. Attention will be given to 1) the innovation, clarity, and style of both the oral presentation at the conference and the manuscript submitted for publication, and 2) the importance of the work to the field.

The finalists will be notified by email before the symposium to present in an oral Special Student Session. If selected as a Finalist, students must confirm their attendance by **2 May** to the Chairs in order to be in consideration.



## A key technical meeting.

The premier worldwide technical meeting for photomasks, patterning, metrology, materials, inspection/repair, mask business, extreme UV lithography, and emerging technologies.

### Conferences:

17-20 September 2018



**2**  
CONFERENCES

### Exhibition:

18-19 September 2018

Monterey Convention Center  
and Monterey Marriott  
Monterey, California, USA



**580**  
ATTENDEES



**150**  
TECHNICAL  
PAPERS

### Two co-located conferences

#### Photomask Technologies

- Computational Lithography
- Mask Technology
- Imaging and Emerging Mask Technologies
- Mask Application
- Mask Business

#### Extreme Ultraviolet Technologies

- Integration in manufacturing
- Tools, including sources and optics
- Masks, mask inspection/repair and review
- Pellicles, mask cleaning and thermal expansion
- Resist materials/process and contamination
- Patterning and process enhancement
- Lithography extendibility

## The mask-making industry's premier event

Join us as an exhibitor or walk the floor to meet key suppliers of mask components, software, and manufacturing equipment.



**25**  
EXHIBITING  
COMPANIES

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Submit abstracts by 2 May 2018

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# GET LASTING VISIBILITY FOR YOUR RESEARCH

Pavan Chandra Konda presented "Scheimpflug multi-aperture Fourier ptychography: coherent computational microscope with gigapixels/s data acquisition rates using 3D printed components" at SPIE Photonics West 2017. Authored by Pavan Chandra Konda; Jonathan M. Taylor; Andrew R. Harvey; doi: 10.1117/12.2251884; CID 100760R.

## Present and publish with SPIE.

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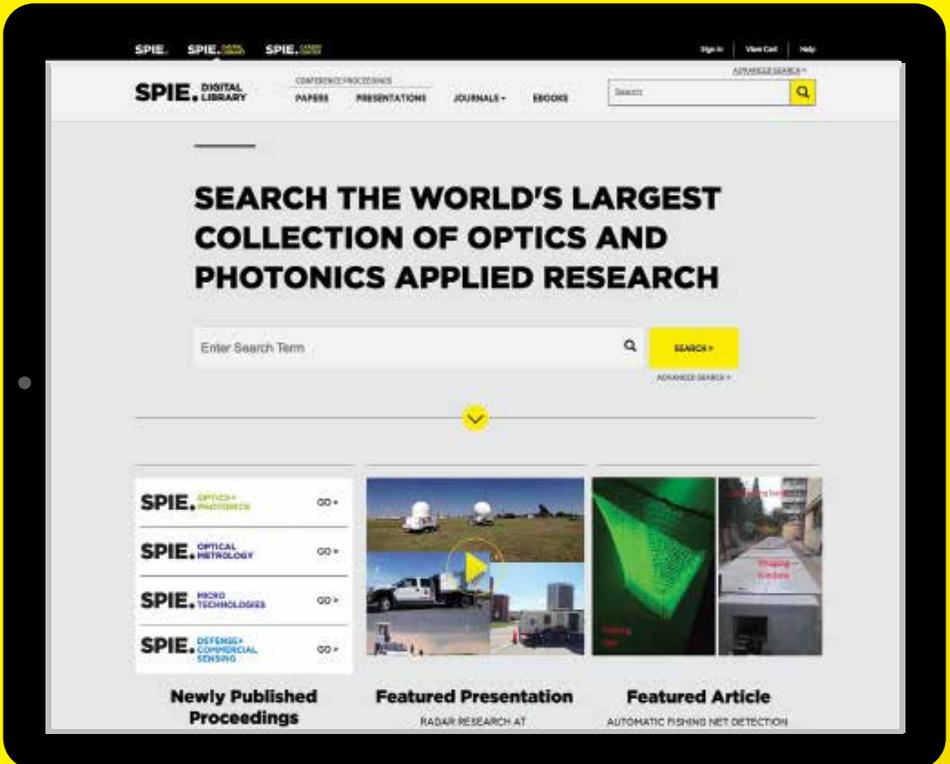
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