Applied Physics Letters

Last 60th salute to the journal

Cite as: Appl. Phys. Lett. **122**, 020401 (2023); https://doi.org/10.1063/5.0139746
Submitted: 22 December 2022 • Accepted: 22 December 2022 • Published Online: 09 January 2023

Alexander A. Balandin, Satoshi Iwamoto, Maria A. Loi, et al.

AIP Publishing

Applied Physics Letters EDITORIAL scitation.org/journal/apl

Last 60th salute to the journal

Cite as: Appl. Phys. Lett. **122**, 020401 (2023); doi: 10.1063/5.0139746
Submitted: 22 December 2022 · Accepted: 22 December 2022 ·
Published Online: 9 January 2023

Alexander A. Balandin, Satoshi Iwamoto, Maria A. Loi, Jenny Stein, and Lesley F. Cohen[a)]

[a)]Author to whom correspondence should be addressed: lcohen@aip.org

https://doi.org/10.1063/5.0139746

Here, we are at the tail end of 2022 and about to say farewell to the APL 60th anniversary celebratory year. We bring a final three points of view from APL Editors, Professor Alex Balandin, Professor Maria Loi, and Professor Satoshi Iwamoto. It is quite telling that these editors encapsulate the geographic reach of the journal, sitting in the Netherlands, the West Coast of the USA, and the busy metropolis of Japan. Reading through their recollections, it is really quite amusing that they independently describe their memory of photocopying *APL Letters* from those huge tomes, their excitement on finding additional stimulating papers relevant to their own research interest, and the joy of sitting down to read the prized photocopied paper after the library ritual and struggles with the photocopier. Well, I guess that things have changed for us all in the interim, including *APL*, a journal still highly respected and guess what—still publishing timely, relevant, and impactful papers in applied physics! Enjoy these trips down memory lane—and for the last time this year from me—happy 60th APL.

Here's to a great 2023 to all our readers, editors, and publishing staff. Best wishes, Lesley.

Deputy Editor, Alexander A. Balandin

Applied Physics Letters reached an age of maturity and wisdom—60 years. Using this opportunity to celebrate the journal, I would like to reflect on what this journal means to me as the reader, author, and editor as well as comment on its value for the professional community. As a Ph.D. student at the Department of Electrical Engineering at Notre Dame, I remember the discussions in the graduate student offices and laboratories about the differences among journals and where it is best to publish to make an impact. What transpired for me from those conversations is that when you have completed a solid systematic research project, you should write a long paper with all the details and publish it in an "archival" journal like the *Journal of Applied Physics*. If in the course of your research work, you come up with an unexpected, unusual result, an interesting twist in the physical interpretation, or a possible application—you should write a brief paper for *Applied Physics Letters* to disseminate your result quickly, attracting the attention of the research community, and afterward, follow up with an archival publication. The notion that a paper in *Applied Physics Letters* should have something special, "the unexpected twist" remains with me still.

Many *Applied Physics Letters* papers that we read and discussed as Ph.D. students produced a lasting profound effect on us. Some papers were vintage from 1970s, others were published in 1990s, my graduate studies years, and became the classics later on. If I have to give some examples, they included "Coherent (visible) light emission from Ga(As1-xPx) junctions" by N. Holonyak and S. F. Bevacqua;[1] "Resonant tunneling in semiconductor double barriers" (1974) by L. L. Chang, L. Esaki, and R. Tsu;[2] "Electronic analog of the electro-optic modulator" (1990) by S. Datta and B. Das;[3] "Hall effect under null current conditions," (1994) by R. G. Mani and K. von Klitzing;[4] "Candela-class high-brightness InGaN/AlGaN double-heterostructure blue-light-emitting diodes," (1994) by S. Nakamura, T. Mukai, and M. Senoh;[5] and "Nanoscale field-effect transistors: An ultimate size analysis," by F. G. Pikus and K. K. Likharev.[6] At that time, quantum wells, resonant tunneling structures, superlattices, quantum dots, and wideband-gap semiconductors were rather new concepts and *Applied Physics Letters* served as a perfect journal and timely venue to deliver important developments at the intersection of physics and technology. The concept of the journal impact factor had not been invented yet and the journal's relevance in terms of its scope, the quality of the papers, and the short time to publication were the most important criteria that made *Applied Physics Letters* special.

Starting from my Ph.D. years, I felt that *Applied Physics Letters* reflects the best of what I like the most in my research—a delicate balance between physics and engineering applications. The applied physics content gives the journal its unique flavor—move too much to one side, and you are lost in the jungles of the page-long derivations of the second-quantization Hamiltonians of the *Physical Reviews*, move too much to the other side, and you walk into the desert-dry description of engineering details of the IEEE Transactions. The draconian page limitation of the original *Applied Physics Letters*—3 pages maximum, no exceptions—also resonated with me, as you have to formulate your message concisely when delivering it to the community, and if you cannot formulate it in this number of pages, perhaps you do not have the message yet—more work required. There was a side benefit to the 3-page paper length. In those days, to get a copy of the paper, one had to go to the library, and struggle with the copy machine, trying to flatten the hardcover bound journal issue collections and copy the paper page by page. When I became a postdoctoral researcher at UCLA,

my interactions with *Applied Physics Letters* were elevated into a new capacity of the reviewer. Receiving a large yellow envelope postmarked at the Argonne National Laboratory gave me a sense of importance. At that time, *Applied Physics Letters* used only one reviewer for the decision, and not many manuscripts were rejected editorially.

When I was already a professor at the University of California, a stroke of luck happened—two of my papers on the "unexpected" origins of 1/f noise in graphene were rejected by *Nature* in the same year, one paper, after a lengthy half-a-year review. It turned out that these, initially unfortunate events, actually helped me become an Associate Editor at *Applied Physics Letters*. In 2013, my noise papers were eventually published in *Applied Physics Letters*.[7,8] Soon after that, I received an invitation to join *Applied Physics Letters* as one of the Associate Editors. The invitation came out of the blue—I did not apply or ask anybody to recommend me. During one meeting with the editors or AIP Publishing personnel, somebody explained to me that my papers on 1/f noise attracted attention and were considered as truly "applied physics," as a result, my name was suggested as an editor. Later, the conclusions of our *Applied Physics Letters* papers on the mobility fluctuation noise mechanism were independently confirmed by other research groups, which coincidentally published their findings in *Applied Physics Letters*.[9,10]

Similar stories happened to some of my papers on phonon transport and thermal properties of graphene and few-layer graphene. These developments made me think about the difference between *Applied Physics Letters* and some other journals, including a few with stellar impact factors. The editors in *Applied Physics Letters* are professors with expertise and experience in their fields. They can use their knowledge to make decisions rather than rely completely on the opinions of the reviewers. The editors of *Applied Physics Letters* can figure out the physics themselves and determine what makes sense and what does not. This is important to have the journal open to new "high-risk" topics, and "unorthodox" research ideas and interpretations. This makes *Applied Physics Letters* a journal of cutting-edge research, which stays relevant and serves the broad professional community for 60 years. It also explains why the impact factors are not the only metric for evaluating the importance of a technical journal.

As with any evolving system, over its 60-year history, *Applied Physics Letters* went through many developmental stages. The quest for "new markets" and the broadening geography of authorship and readership in the 2000s–2010s resulted in the need for strengthening the rigor and consistency of the review process. This was accomplished under the leadership of Editor-in-Chief Reuben T. Collins. The introduction of the default two-reviewer process and strict editorial screening with the increased number of rejections without review produced a positive effect on the journal. I enjoyed being part of this important stage of the journal's history as the Deputy-Editor in Chief. The period of 2014–2019 is also memorable to me from the *Applied Physics Letters* receptions organized during the Materials Research Society (MRS) Spring Meetings in Phoenix, Arizona. Those were great opportunities to meet and interact with the authors and hear, after a couple of glasses of wine, what they really think about you and your past rejection decisions.

The late 2010s and early 2020s brought new challenges—fast-increasing competition from other journals, often for-profit publications. This problem is being effectively dealt with by the new Editor-in-Chief Lesley F. Cohen. I believe that the increased emphasis on commissioned content, including special topic issues and perspectives, became a success story for the *Applied Physics Letters*. I enjoy proposing topics of future issues, those that I feel reflect the nature of *Applied Physics Letters*. This allows the journal to remain relevant by entering new research areas, which are ripe for evolving from "pure physics" to "applied physics." The experience of working on the special topic issue and the editorial "Charge-density-wave quantum materials and devices—New developments and prospects" with the pioneers of the field, G. Grüner and S. V. Zaitsev-Zotov, was unique and rewarding.[11] The special topic issue "One-dimensional van der Waals materials—Advent of a new research field",[12] on which we worked with T. Salguero and R. Lake, will remain memorable as an experience in defining a new area or field of quantum materials research.

Concluding, I hope that science journals can live longer than humans, and reaching the diamond age would not stop *Applied Physics Letters* from evolving together with the research community, and continuing to educate and inform future generations to come. Happy 60 years APL!

I would like to thank Editor-in-Chief Dr. Lesley F. Cohen and Journal Manager Dr. Jenny Stein for their encouragement to write about APL in its 60 anniversary.

Deputy Editor, Maria A. Loi

My first encounter with *Applied Physics Letters* was in the mid-90s during my Master's and then my PhD thesis. This was a revolutionary time for the scientific literature and the way it was distributed. Email was already present, but as a Master's student I would still go to copy the articles in the library, looking for them in a very large index book reporting the abstracts. It was a very delicate and tiring job that would make you treat the literature as sacred text. To conquer one of these relevant papers, I would read it many times, underlining the most beautiful and relevant facts. However, this very tiring practice was not there to stay with the capillary diffusion of computer systems, already at the end of the 90s we could enjoy using database systems to do our literature search. While this made life easier, it also made the literature a bit less holy.

However, let's go back to APL, being trained as a physicist at the time of my Ph.D., the aim was to publish in *Physical Review Letters*. However, it was already clear to me, that when you would have at hand something very cool, that could eventually be applied, then APL was the place to go. Needless to say, this was a bit too difficult for me as a Ph.D. student to cope with, and I would publish my first papers in APL only after my Ph.D.

APL is today 60 years old—in the last 20 years, the landscape of scientific literature has been largely modified and revolutionized with the appearance of many new players. However, APL still maintains its nature, of a journal for fast dissemination of very cool Applied Physics. It is still a place where very precious gems can be found, gems that are not always obvious and that take time to recognize as a gem, definitely more than the two years on which the impact factor is defined.

Here, I would like to bring two examples that are not only close to my interest but are also motivational and show with illuminating clarity that quality does not age.

I was still in high school when C. W. Tang and S. A. van Slyke published an article about the fabrication of the first thin film organic light emitting diode that as of today has been cited 12,552 times in the

scientific literature and more than 1300 times in patents.[13] This was one of the manuscripts I copied in the library, going back in time with my treasure search.

What is fascinating is that reading the manuscript, the claims are rather modest, looked at with the eyes of today: "external quantum efficiency (1% photon/electron), luminous efficiency (1.5 lm/W), and brightness (>1000 cd/m2) are achievable at a driving voltage below 10 V." However, this paper is what we define pioneering as it has moved a large community of scientist and engineers, at the end giving rise to one of the most acclaimed technologies of today (organic light emitting diodes (OLEDs) are nowadays a commercial display technology). My next example is also very bright. This APL paper by the future Nobel prize winner Shuji Nakamura with his colleagues Takashi Mukai and Masayuki Senoh has been cited about 3000 times.[5] In the article, they described an InGaN/AlGaN double-heterostructure with external quantum efficiency as high as 2.7% at a forward current of 20 mA at room temperature. The peak wavelength and the full width at half-maximum of the electroluminescence were 450 and 70 nm, respectively. Furthermore, they commented that "This value of luminous intensity was the highest ever reported for blue LEDs." In 2014 Nakamura won the Nobel Prize in Physics together with Isamu Akasaki and Hiroshi Amano for giving humanity an efficient blue-light-emitting diode that has revolutionized lighting and nowadays saves enormous amount of energy. As a side effect, they also created a multibillionaire business, which was estimated to 16 billion dollars in 2014.

I will conclude wishing APL happy birthday and to continue for the many years to come, as important to the community as in the past, and continuing to bring the gems of the Applied Physics community to light.

Associate Editor, Satoshi Iwamoto

I joined the team as an associate editor in June 2021. Although I am a rather new face, I feel very honored to be contributing to the magazine as an associate editor in the year of APL's 60th anniversary.

It was more than a quarter of a century when I first read an article in APL. Since then, APL is one of my favorite journals, both from the viewpoint of a reader and as an author. At that time, I often went to the university library to make a copy of the paper I needed. I remember clearly that I sometimes came across interesting papers unexpectedly while flipping through the pages. Particularly important papers for me personally are the reports published by E. Yablonovitch and his coworkers about the method of peeling a semiconductor thin film from a substrate[14] and bonding it to another substrate.[15] At the time, I was working on nonlinear optics in semiconductors and needed to peel the quantum well thin film from the substrate. I remember reading those papers so many times until I "burned a hole" in them. Based on the technologies reported in them, I was finally able to realize the devices I aimed at, and I was able to obtain a Ph.D. degree. I was extremely excited when I had an opportunity to talk with Yablonovitch directly for the first time after I started research on photonic crystals.

I have been working in the field of optoelectronics and photonics. APL has been an important journal leading the development of these fields. Coincidently, semiconductor lasers are celebrating their 60th anniversary this year, too. Three of four pioneering studies were published in the first volume of APL.[1,16,17] Quantum dot lasers, which are a kind of semiconductor lasers showing low threshold current density and high-temperature stability, were proposed by Y. Arakawa and H. Sakaki in APL in 1982, 40 years ago.[18] Quantum dot lasers are now already commercially available. Other historical studies and recent notable progress in the relevant fields can be found in APL Classic Papers and in Special Topic Collections, respectively. I strongly believe that APL will continue to be the field-leading journal in optoelectronics and photonics, needless to say, in other fields of applied physics.

Journal Manager, Jenny Stein

I couldn't help but add my own memory of *Applied Physics Letters* after reading the other contributions related to hunt down articles at the library. During my undergraduate studies, I worked part-time at the university library for 3 years and my primary responsibility was shelving and organizing the physical sciences section—this turned out to be fairly complementary to the chemistry degree I was pursuing! All of those APL tomes that someone pulled off the shelf to photocopy would inevitably end up on my desk to put back. While tedious work, I always enjoyed seeing what articles others had sought out. My favorite task though was when we had several months of individual issues that required binding. The librarians would leave me with a hard cover, hole-punched issues, and the biggest (and thankfully dull) needle I'd ever seen to sew together the issues into one heavy tome for the waiting shelves—and the hungry eyes of our editors! It is a delight that APL can have such a strong and rich history and surprise us with these unexpected connections to this day. Happy 60th APL!

REFERENCES

[1] N. Holonyak and S. F. Bevacqua, "Coherent (visible) light emission from $Ga(As_{1-x}P_x)$ junctions," Appl. Phys. Lett. **1**, 82–83 (1962).
[2] L. L. Chang, L. Esaki, and R. Tsu, "Resonant tunneling in semiconductor double barriers," Appl. Phys. Lett. **24**, 593 (1974).
[3] S. Datta and B. Das, "Electronic analog of the electro-optic modulator," Appl. Phys. Lett. **56**, 665 (1990).
[4] R. G. Mani and K. V. Klitzing, "Hall effect under null current conditions," Appl. Phys. Lett. **64**, 1262 (1994).
[5] S. Nakamura, T. Mukai, and M. Senoh, "Candela-class high-brightness InGaN/AlGaN double-heterostructure blue-light-emitting diodes," Appl. Phys. Lett. **64**, 1687 (1994).
[6] F. G. Pikus and K. K. Likharev, "Nanoscale field-effect transistors: An ultimate size analysis," Appl. Phys. Lett. **71**, 3661 (1997).
[7] G. Liu, S. Rumyantsev, M. S. Shur, and A. A. Balandin, "Origin of 1/*f* noise in graphene multilayers: Surface vs. volume," Appl. Phys. Lett. **102**, 093111 (2013).
[8] M. Z. Hossain, S. Rumyantsev, M. S. Shur, A. A. Balandin, M. Zahid Hossain, S. Rumyantsev, M. S. Shur, and A. A. Balandin, "Reduction of 1/*f* noise in graphene after electron-beam irradiation," Appl. Phys. Lett. **102**, 153512 (2013).
[9] T. Wu, A. Alharbi, T. Taniguchi, K. Watanabe, and D. Shahrjerdi, "Low-frequency noise in irradiated graphene FETs," Appl. Phys. Lett. **113**, 193502 (2018).
[10] A. Cultrera, L. Callegaro, M. Marzano, M. Ortolano, and G. Amato, "Role of plasma-induced defects in the generation of 1/*f* noise in graphene," Appl. Phys. Lett. **112**, 093504 (2018).
[11] A. A. Balandin, S. V. Zaitsev-Zotov, and G. Grüner, "Charge-density-wave quantum materials and devices—New developments and prospects," Appl. Phys. Lett. **119**, 170401 (2021).
[12] A. A. Balandin, R. K. Lake, and T. T. Salguero, "One-dimensional van der Waals materials—Advent of a new research field," Appl. Phys. Lett. **121**, 040401 (2022).

[13]C. W. Tang and S. A. van Slyke, "Organic electroluminescent diodes," Appl. Phys. Lett. **51**, 913–915 (1987).
[14]E. Yablonovitch, T. Gmitter, J. P. Harbison, and R. Bhat, Appl. Phys. Lett. **51**, 2222 (1987).
[15]E. Yablonovitch, D. M. Hwang, T. J. Gmitter, L. T. Florez, and J. P. Harbison, Appl. Phys. Lett. **56**, 2419 (1990).
[16]M. I. Nathan, W. P. Dumke, G. Burns, F. H. Dill, Jr., and G. Lasher, Appl. Phys. Lett. **1**, 62 (1962).
[17]T. M. Quist, R. H. Rediker, R. J. Keyes, W. E. Krag, B. Lax, A. L. McWhorter, and H. J. Zeigler, Appl. Phys. Lett. **1**, 91 (1962).
[18]Y. Arakawa and H. Sakaki, Appl. Phys. Lett. **40**, 939 (1982).