SPRING 2014 NEWSLETTER

Leonard Brillson
Editor, INTERSECTIONS
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WELCOME TO OUR SPRING 2014 NEWSLETTER!

House and Senate Appropriations Committees have begun their deliberations, impacted by last year’s tumultuous fiscal events and with major consequences for federal funding of research. The MRS Government Affairs Committee aims to understand the dramatically changing policy environment and its impact on materials research. Ron Kelley describes the significance of these events and how MRS has worked to highlight the importance of continued support for U.S. science and technology. He points out the pressure that agencies that support materials research are under and the significance of our letter-writing campaigns and Congressional visits. Tabetha Dobbins, Grassroots Subcommittee Chair, emphasizes the importance of these letter-writing activities and describes the three new letters developed this year for our members to sign and send. Kevin Whittlesey, Congressional Science & Engineering Fellows Subcommittee Chair, announces our two new Congressional Fellows, stellar MRS members who will continue what is now a 20-year tradition of Fellows on Capitol Hill. Linda Olafsen describes this spring’s MRS Congressional Visits Day events, meeting Senators, Congressmen and women and their staffs to convey the impact of federal support for science back home in their states and districts. In the past few years, MRS CVD participants have established relationships with the Congressional offices of all but a handful of states. David Norton describes the information sessions and presentations made at the 2014 MRS Spring Meeting by leaders from five key federal agencies supporting materials research. Past Government Affairs Committee Chair, Duane Dimos, announces the creation of the Policy Subcommittee, which he will chair. This new subcommittee will recommend positions to MRS governance on developing policy issues generated by other organizations with advocacy efforts in Washington as well as issues where MRS technical expertise is valued. Finally, the INTERSECTIONS article on value-added materials science in this issue features yet another success story, highlighting how investments in materials science paid off in ways that the general public and especially our elected officials can relate to. MRS is working hard to make sure that the materials research community is being heard and that it has input in developing effective government policy for support of materials science. Here is the latest news.

A MESSAGE FROM OUR GOVERNMENT AFFAIRS COMMITTEE CHAIR

Nabil Bassim
Chair, Government Affairs Committee

Dear MRS Membership! As Chair of the Government Affairs Committee (GAC), I hope that you enjoy the latest issue of INTERSECTIONS, our quarterly chronicle of all things policy related in the materials world. The first quarter of the year has been very active, with many events at the Legislative and Executive level, which you will be able to read in the forthcoming articles. From the budgetary process, to the Materials Genome Initiative, to the availability of natural resources such as helium, GAC remains active and engaged on behalf of all MRS members. A new initiative (outlined below), the Policy Subcommittee, will serve to scope out and recommend new public policy issues and stances for the Society to pursue and examine. Stay tuned!

If you are interested in participating in GAC, please do! Contact us through the MRS feedback email. We hope that you enjoy the rest of the INTERSECTIONS newsletter!

WHAT’S HAPPENING IN WASHINGTON

Ronald L. Kelley
MRS Washington Consultant

The President’s Budget Request for FY2015 was sent to Congress in early March with very restricted budgets for basic research for both federal health sciences and physical sciences. While the budgets are favorable to applied research in energy programs at DOE and some manufacturing initiatives in many agencies,
it does not even keep up with inflation for NSF and is significantly below current year funding levels for all defense S&T accounts.

Appropriations bills in Congress have begun with the two-year agreement passed last December which give top line guidance to all subcommittees with some temporary relief from sequestration. Both the Senate and the House are completing draft legislation for FY2015. The S&T initiatives in the Administration’s proposed budget are largely being ignored by both Senate and House Appropriators, in favor of the budget agreement. MRS has been very active with visits on Capitol Hill throughout the last three months advocating with both our coalition partners and with our MRS CVD teams and through our letter-writing programs for MRS members.

We have been emphasizing the science budget 'innovation deficit’ that continues to build as federal program dollars have been dramatically lowered and our global competitiveness has been impacted vs. other countries who have aggressively committed to science funding. Recent foreign country comparisons by ITIF, National Science Board, and Battelle are being used in the facts we present to make this deficit understood by staff and Members of Congress.

Expected outcome in this year will be only modest increases or slightly reduced FY2015 budgets compared to current year. It is also expected that we will have only a few budgets resolved by the start of the new fiscal year on October 1. Most of the bills will be finished later in the calendar year after the mid-term elections. Even with a continuing resolution, the level of funding will be virtually the same so that less trauma will be experienced this year for the federal agencies as they plan for their programs. To restore future budgets in the next five years to pre-2008 levels will take a very coordinate advocacy effort by MRS and the overall science community in the current budget environment.

As the current year programs are executed by the federal agencies, a recent concern for grants from DOE to universities that are under $1M in size are now required by law for multiyear programs to be funded from existing year funds. The effect in this first year is to lower the total number of university recipients by about 20%. In an already tight fiscal budget environment, this is a further disadvantage for programs from the Office of Science.

MRS along with APS endorsed S.1600 Critical Minerals Policy Act of 2013, a bipartisan bill proposed by Senators Wyden, Murkowski, and Udall. The bill has a number of the recommendations from the APS / MRS policy study on Energy Critical Elements on rare earth element and other critical materials. The bill is expected to be marked up in the Senate Energy and Natural Resources Committee prior to summer.

COMPETES reauthorization continues to be addressed by the House Science Committee with a series of fairly controversial measures. It is not clear that there will be a reauthorization of this bill for the principal science agencies that will meet the many objectives of both external stakeholders as well as both sides of the political aisle. The Senate has yet to release their version, and it is expected to be more consistent with prior authorizations modeled after the NAS study on 'Rising Above the Gathering Storm'. The National Science Foundation continues to be placed under more scrutiny than justified by the House version of COMPETES, currently named the FIRST Act.

The mid-term elections for all House members and a third of the Senate have particular significance for potential switch in majority control of Congress. Republicans feel they have a reasonable chance of control of both bodies after the November election. Many senior Members of Congress have already announced their plans to retire this year. Some of these Members have been staunch long-term supporters of science—e.g. Senator Rockefeller, Congressmen Wolf, Dingell, and Miller. Analysis of the changing nature of Congressional voting patterns further demonstrate the loss over the last 30 years of "moderates" in both chambers as the so-called extreme right and left of our two political parties are now the norm (see Washington Post article).

LET OUR VOICES BE HEARD AT THE 2014 MRS SPRING MEETING

Tabbetha Dobbins  
Chair, Grassroots Subcommittee

Dear MRS Members—Our voices are being heard on Capitol Hill! At the 2014 MRS Spring Meeting, 844 letters (by 70 participants) were sent to Capitol Hill. These three letters are still available for sending to your representatives via the MRS Public Affairs Alert. The letters address the topic of: (1) “Maintain U.S. Global Competitiveness by Supporting Sustainable Funding Levels in FY15 Budget for Scientific Research”, (2) “Reauthorize the America COMPETES Act—Preserve U.S. Leadership in Scientific Research and STEM” and (3) “OMB Reduced Travel Allowances for Government Employees.” As well, you may compose your own letter addressing your specific concern. In the coming days and weeks, please take the following two actions: (1) log in to www.mrs.org/materials-voice and send your letters to your representatives and (2) share the link to our Public Affairs Alert page with your colleagues, friends, and family members so that they can do the same.

I want to thank the Materials Voice Kiosk student volunteers who helped attendees at the Spring 2014 meeting send their letters. The students are:

- Boris Dyatkin, Drexel University
- Charles (Chenggong) Wang, Rochester Institute of Technology
• Anastasia Iefanova, South Dakota State University

Thank you! Your efforts made this letter-writing campaign a success.

I also want to thank those GAC members (and other MRS Volunteers) who stopped by to provide encouragement to our student volunteers at the 2014 MRS Spring Meeting. Truly, these students are the future of our organization. Thank you to Anshul Vyas and Len Brillson of the GAC Grassroots subcommittee as well as Megan Brewster (former GAC Grassroots subcommittee). Thank you to many other volunteers and MRS leadership who stopped by to cheer on our student volunteers and our efforts to send letters to Washington, DC.

As always, please remember to “follow” or “friend” MRS using social media (Facebook, Twitter, etc.) to get the latest in MRS activities and to post or re-post articles concerning automatic cuts to science funding and their impacts. In doing so, you will inform others, scientists and non-scientists alike, of the urgency of these issues.

MRS CONGRESSIONAL SCIENCE & ENGINEERING FELLOWSHIP CORNER

Kevin Whittlesey
Chair, Congressional Fellow Subcommittee

The Congressional Fellowship subcommittee is just wrapping up its busiest part of the year. A strong pool of applications was received for the 2014-2015 Fellowship term and the committee, in collaboration with representatives from our partner societies, completed the selection of our new Fellows with interviews conducted in Washington, DC in early April.

I am pleased to announce our incoming Fellows! The 2014-2015 MRS/OSA Congressional Science and Engineering Fellow will be Jimmy O’Dea. Jimmy completed his PhD in Chemistry at the University of California in Santa Barbara in 2010 and is currently a postdoctoral fellow at Cornell University’s Energy Frontier Research Center. His policy interests include energy and open government issues. The 2014-2015 MRS/TMS Congressional Science and Engineering Fellow will be Adria Wilson. Adria recently completed her PhD in Chemistry at Duke University. Her policy interests include renewable energy technology, environmental conservation, and STEM education. The committee will be inviting former MRS Congressional Fellows in the Washington, DC area and select GAC leadership to welcome our incoming fellows with the annual kick-off breakfast in September just before they begin their program orientation with AAAS. It is important to note that the matriculation of the new Fellows this fall will mark the 20th term for our Congressional Fellowship program. I am proud that MRS has such a long standing tradition with this program. It is a significant commitment of advocacy resources and one that we all know the MRS and scientific enterprise benefits from tremendously. I look forward to seeing many more years of Congressional Fellows sponsored by the MRS!

In other news, we continue to look for opportunities to interact with our current Fellows and keep them up to date on the GAC activities when appropriate. Some MRS members who were in Washington, DC for Congressional Visits Day on April 3rd had the opportunity to visit with our current Fellows, Sydney Kaufmann (MRS/OSA) and Megan Brewster (MRS/TMS). The CVD delegates enjoyed hearing about what the transition to life on Capitol Hill has been like, and we were happy to connect with the Fellows with more of our MRS members who have an interest in science policy and advocacy.

The Congressional Fellowship Subcommittee continues to hold informational sessions at the MRS meetings, which have been a great outreach tool. We held the most recent informational session at the 2014 MRS Spring Meeting to inform potential applicants about the program. I provided an overview of the program, and Ashley White (2010-2011 MRS/OSA Fellow) and Megan Brewster (2013-2014 MRS/TMS Fellow) joined me as panelists to share their experiences. The session was well attended and garnered significant interest. We know now that these sessions have been effective, since at least one finalist for each of the last several years first found out about the program at one of these information sessions. I was very pleased to see direct benefits from our outreach efforts and look forward to the opportunity to continue to build on the great track record of our program!

SPRING 2014 CONGRESSIONAL VISITS DAY

Linda Olafsen
Chair, Congressional Visits Day Subcommittee

Twenty-two MRS volunteers ascended Capitol Hill on April 3 to thank members of Congress for their previous support of funding for scientific research and to bring new examples and stories about the impact scientific research funding has on the U.S. economy as well as the country’s competitiveness in technology. There were a total of 65 office visits, including friendly visits to the current MRS Congressional Fellows, Sydney Kaufman in the office of Senator Mark Begich and Megan Brewster in the Senate Energy and Natural Resources Committee Office. The other 63 visits covered 19 states, and many of the offices visited have members in House or Senate leadership or who serve on the appropriations or science committees most closely related to funding of the National Science Foundation,
Department of Energy Office of Science, National Institute of Standards and Technology, and Department of Defense Basic Research.

The map above shows the 19 states shaded in green that were visited by MRS volunteers during the April 3 Congressional Visits Day event (AL, AZ, CA, FL, ID, IL, MD, MI, MT, ND, NJ, NM, NY, OR, PA, SC, SD, TX, VA). The states shaded in pink denote locations from which materials scientists were invited but unable to participate in this spring. States shaded in purple represent those visited by MRS volunteers in the past several years.

MRS volunteers presented examples from their own laboratories, companies, and districts with the staff and Members of Congress with whom they met. There were more than 10 meetings where volunteers had the privilege of interacting directly with their Members of Congress, including one impromptu opportunity where the CVD volunteer ate dinner and flew back to the district with her senator. The follow up on visits has been very positive, with quite a few staff members responding to prompt thank you notes and inquiring about legislation and issues of interest to the Materials Research Society.

More than half of the volunteers were first-time participants in CVD, with the guidance of CVD veterans and Washington, DC MRS representatives Ron Kelley and Lisa Arafune, they were able to become comfortable quickly with delivering the request and sharing the impacts of federal funding of scientific research. There also was strong evidence of relationships being built where returning CVD participants met with members and staff with whom they have previously met, reinforcing the message and supplying updated examples and information. Lisa was working with Ron and the CVD team for the first time, and volunteers benefited greatly from her experience in government relations and advocacy.

In each office a folder of materials is left behind to summarize and reinforce the request of Congress. During this event, two notable additions to that folder were a new brochure on Materials by Design. The CVD Subcommittee is grateful to Gopal Rao, Laura Bartolo, Beckie Yokum, Anita Miller, and Rachel Fornataro for their expert assistance in preparing this new item. Another useful document described the Innovation Deficit – “the widening gap between the actual levels of federal government funding for research and higher education and what the investment needs to be if the United States is to remain the world’s innovation leader.” This document includes supporting charts and a link to the compelling video at www.innovationdeficit.org.

The CVD Subcommittee is grateful to Ron Kelley and Lisa Arafune for their organization and leadership, Jocelyn Goldblatt for her early work on the priority list of Congressional offices, Donna Gillespie for all the essential logistical support, and to the volunteers themselves who made the time to visit Washington, DC and advocate on behalf of the materials science community.
Linda Horton, Director of the Materials Sciences and Engineering Division within the Office of Basic Energy Sciences in the U.S. Department of Energy, provided a useful overview of the materials research opportunities within the Office of Basic Energy Sciences. This Office supports fundamental research and manages several national user facilities relevant to the materials science community. Several DOE program managers were also in attendance and were introduced during the talk. Topics discussed ranged from predictive modeling to experimental condensed matter physics. She highlighted efforts within her office to support the Materials Genome Initiative, a growing activity that seeks to leverage advances in computational modeling, theory, and experiment into a realization of “materials by design”. In general, computational materials science and modeling were viewed as growth areas with expectations for open source codes, multi-scale validated computational software, and the integration of code with databases. In her talk, she also discussed the new competition of the Energy Frontier Research Centers (EFRCs). The administrative and funding challenge of the new requirement that financial assistance awards less than $1M be fully funded within a single fiscal year appropriation was also discussed.

Mary Galvin, Director of the Division of Materials Research (DMR) at the National Science Foundation, provided an excellent overview of programmatic focus and funding opportunities within DMR. The DMR budget is approximately $300M/yr. This division reviews over 2000 proposals/yr. in reaching funding decisions. Galvin’s talk emphasized the various DMR programs within her office. Among the large programs discussed were the Materials Research Science and Engineering Centers (MRSEC) and the Science and Technology Centers (STC). She also emphasized the cross-agency involvement in the Materials Genome Initiative, highlighting a specific program, Designing Materials to Revolutionize and Engineering the Future (DMREF), where projects must be collaborative and truly iterative between theory and experimental, going beyond conventional approaches. Other programs discussed included Sustainable Chemistry, Engineering, and Materials, CAREER, Materials Research Instrumentation, and Software Infrastructure for Sustained Innovation.

Dane Boysen, Program Director at ARPA-E, described the mechanics of how ARPA-E defines and supports specific technical areas and objectives. ARPA-E Program Director positions are limited to 3 years in which time they propose and run a program that addresses either transportation or stationary energy challenges. While there are new programs emerging on a routine basis, an open solicitation is issued just once every 3 years. He also described the Open IDEAS solicitation that is always open, funds projects at a level up to $500,000, but with a duration of less than 1 year. For this, one needs a program director to champion the idea within ARPA-E.

Dr. David Stepp, Materials Science Division Chief at the Army Research Office, described the mission of his division as identifying pathways to unprecedented materials properties and extending the frontiers of materials science. He described his division’s programs within the areas of Mechanical Behavior of Materials, Physical Properties of Materials, and Synthesis and Properties. One new area discussed was force-activated synthetic biology which is the topic of a recently funded Multidisciplinary University Research Initiative (MURI). While the focus of ARO is primarily on supporting single investigator projects, he did indicate some opportunities for multi-investigator projects with the MURI program being the most obvious.

The final speaker was James Warren, Technical Program Director of Materials Genomics at NIST. Warren provided an overview of NIST efforts in advanced manufacturing, describing the Advanced Manufacturing Technology Consortia and the National Network for Manufacturing Innovation. Warren also provided an overview of NIST efforts within the Materials Genome Initiative, and the multi-agency efforts to address some of challenges in creating the materials innovation infrastructure that lies at the heart of the MGI. Within MGI, he emphasized the need for sharing within the community, for partnering between government, industry, and academia, and for innovating within teams of theorist and experimentalist. NIST is working with partners in industry, academia and government to develop the tools, standards and techniques needed to enable materials data exchange and the means to ensure the quality of materials data and models needed to foster widespread adoption of new materials development approaches such as of “materials by design”. He also discussed a newly formed NIST Office of Data and Informatics.

After the talks, the agency speakers made themselves available for individual questions and discussion.
general, the Forum was well attended and successful at providing MRS meeting participants the opportunity to hear directly from agency representatives and to engage them one-on-one to explore how various programs might benefit their research efforts.

**NEW POLICY SUBCOMMITTEE**

*Duane B. Dimos*  
*Chair, Policy Subcommittee*

This past December, the MRS Board of Directors approved Government Affairs Committee (GAC) chair Nabil Bassim’s proposal to establish a Policy Subcommittee. Two important ideas drove this proposal. On one hand, MRS is being increasingly asked to take a position on arising policy issues by other organizations doing advocacy work in Washington, especially other professional societies. Such policy issues may relate to a proposal being developed by the President’s administration through a government agency or office (e.g., the Office of Science and Technology Policy), or to a bill being developed in Congress. The fact that other advocacy groups seek out our voice recognizes the very positive reputation MRS has been developing over a number of years in Washington circles.

Another issue that drove establishing a Policy Subcommittee was the substantial technical expertise we have that can inform emerging policy issues. A great example of this is a study we co-sponsored with the American Physical Society (APS) in 2010 on emerging shortages of critical materials, such as rare earth elements and He. Former MRS Presidents Alex King and Al Hurd served on the study’s committee – a great example of MRS’s in-house expertise. The report and subsequent advocacy efforts on this subject resulted in Congressional hearings and a new law addressing the national He supply. There are other areas where our expertise can help shape national policy in a similar manner.

After my three-year term on the Board ended in 2013, I agreed to establish this new subcommittee as the chair. As a former chair of GAC (2008-2010), I am really pleased to be back working with the GAC in this capacity. I am also excited to get an experienced and knowledgeable group of individuals as the initial set of Policy Subcommittee members: Carolyn Duran: Intel Corp., Director of Chemical Risk and Compliance for Global Sourcing and Procurement; George Dougherty: Director, Price Waterhouse Coopers; Howard Katz: Department Chair, Materials Science & Engineering, Johns Hopkins University and past President of MRS and IUMRS; Andrew (Drew) Steigerwald: AAAS Science and Technology Policy Fellow, U.S. Agency for International Development and former MRS Congressional Fellow; Ashley White: Senior Research Fellow, U.S. Green Building Council and former MRS Congressional Fellow.

There are numerous policy issues that could impact the materials community and where our expertise could provide a valuable perspective. Some examples include open access to data, advanced manufacturing initiatives, visa issues for work and travel, energy policy, next generation computing, global competitiveness, and environmental sustainability. The Subcommittee’s initial discussions are about which issues we might first tackle, and the various approaches we can take to providing meaningful input to policy makers. Over time, I also plan to expand the Subcommittee membership to include more international participation, since most policy issues we are considering have international implications.

As a final thought, I would be happy to hear from any members who have a strong interest in a policy issue and would like to contribute their time and knowledge to helping us develop a position on that issue. I can be reached at dbdimos@sandia.gov.

**A VALUE-ADDED MATERIALS RESEARCH STORY**

*The Genesis of Cree Research, Inc.*

*Robert F. Davis*  
*Carnegie Mellon University*

The desire for both microelectronic devices having at least a dual combination of high-power, high-temperature and high-speed that considerably exceeded the capabilities of Si and blue light-emitting optoelectronic devices to integrate with GaAs-based green and red light-emitting diodes to produce white light had existed for many years prior to 1975 when I initiated a research program on SiC microelectronic devices at North Carolina State University. SiC and GaN had been the primary materials for the earlier studies for these respective applications. However, commercialization of devices was not realized.

Our initial studies borrowed on the ongoing research at NASA-Glenn concerned with the growth of beta SiC films on converted Si(100) surfaces and the recent advances in hydride vapor phase epitaxy. Lack of interest in our studies allowed the students and me to work in coveted isolation from telephone calls and visitors. Attendance at our society presentations was low until functioning devices were realized and characterized.

A vertically integrated team was formed at the outset with the goal of devices operable at high-temperatures. Division of tasks among the team members and excellent collaboration with external groups in the US and Europe resulted in several successful “firsts” in the SiC field including high-temperature ion implantation and simultaneous activation of n- and p-type dopants, development of reactive ion etching processes, new materials for ohmic and Schottky contacts, and the
fabrication of metal-oxide-semiconductor field-effect transistors capable of extended operation to 650°C (a record that still stands).

All of the above research was conducted using the beta-SiC films; however, the very large densities of defects mitigated commercialization of our SiC devices. Growth on SiC substrates was the obvious next step; however, no commercial source existed. I knew that SiC crystals with atomically smooth (0001) surfaces formed at blow-out points in the huge Acheson reactors used to make SiC for abrasive powders. The kindness of a producer of this material permitted one student and I to travel to Niagara Falls, NY in February. With the aid of plant workers, a pick ax and a front end loader we extracted approximately 50 large SiC crystals with excellent [0001] faces. TEM research revealed that the use of vicinal [0001] surfaces allowed growth of commercially viable films with considerably reduced defect densities, if we could produce SiC bulk crystals and wafers with much higher purity. A large reactor was subsequently commissioned for the successful vapor phase transport (VPT) growth of SiC crystals. Numerous invention disclosures and patent applications were filed by NCSU and eventually granted.

Within this team there was one student who possessed the entrepreneurial spirit and the drive to form a start-up company, namely Cree Research, Inc. (later shortened to Cree, Inc.) with selected members of the university graduate student team to commercialize SiC-based devices grown on SiC substrates. Initially, no organization was willing to risk funding of device development and commercialization in a material that already had a rather long history of difficulty in moving laboratory research into production. Start-up funds were derived from maxing out credit cards of team members. The university licensed the inventions and patents to the company. Members of the team continued to develop the material and to work toward a product in my laboratories. The VPT reactor for bulk crystal growth was loaned to Cree by NCSU. Over the next year the company acquired angel funds, hired additional personnel and determined the initial product goals of SiC wafers and high-temperature and high-power transistors. However, micropipes in the wafers trepanned from the bulk crystals proved difficult to eliminate, and the time-line to achieve the device goals became significantly extended. Fortuitously, the goal was changed to the development of blue light-emitting SiC-based LEDs. Thus equipment for fabricating LEDs was in place at Cree, and the team was trained in the fabrication of these devices when the achievement of p-type GaN heralded the replacement of SiC by the much more efficient III-nitrides. Cree moved quickly to initiate growth of nitride films and LEDs. Their success in both the commercialization of SiC LEDs and SiC wafers positioned them well to use the latter for substrates for the nitrides.

In summary, a leap of faith and sufficient funding by an ONR contractor to a young Assistant Professor and his team of students with no experience in either growth of thin films or device-related research but a willingness to learn and work collaboratively ultimately resulted in the emergence of the first commercially viable devices in a wide band gap material. Entrepreneurial efforts resulted in the formation of a start-up company, initially devoted to the development of SiC crystals, wafers and devices and, subsequently, to nitride-based optoelectronic devices, that now employs more than 2000 people.

**FEEDBACK**

You are receiving this newsletter as a subscriber to INTERSECTIONS, the MRS Public Affairs Alerts, or because of your participation in our Materials Voice letter-writing campaigns. We welcome your feedback and invite you to submit topics for consideration in future issues of this newsletter. If you have or know of stories that illustrate how an investment in materials research paid off in real dollar terms, please send your suggestions to INTERSECTIONS Editor, Len Brillson, at brillson.1@osu.edu. Please send your comments to publicaffairs@mrs.org.

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