

# ENTREPRENEURSHIP IN MATERIALS SCIENCE

To learn what makes entrepreneurs in materials science tick, we turned to seven of ASM's inventors and business founders for insight. Following are their perspectives on how they got started, lessons they learned along the way, what ASM can do to support innovators, and advice for the next generation of STEM entrepreneurs.

## ASM PANEL OF EXPERTS



**Aaron Birt**  
Co-founder and CEO  
Solvus Global LLC



**Ho Lun Chan**  
Ph.D. candidate  
University of Virginia  
Co-founder  
Materia Technologies LLC



**Frauke Hogue, FASM**  
President and Metallographer  
Hogue Metallography



**Hanchen Huang, FASM**  
Provost  
UMass Dartmouth  
Co-founder  
MesoGlue Inc.



**Mukta Kulkarni**  
Owner and Managing Director  
Industrial Enterprises, India



**Jean Mozolic, FASM**  
Manager and Founder  
The Mozolic Group



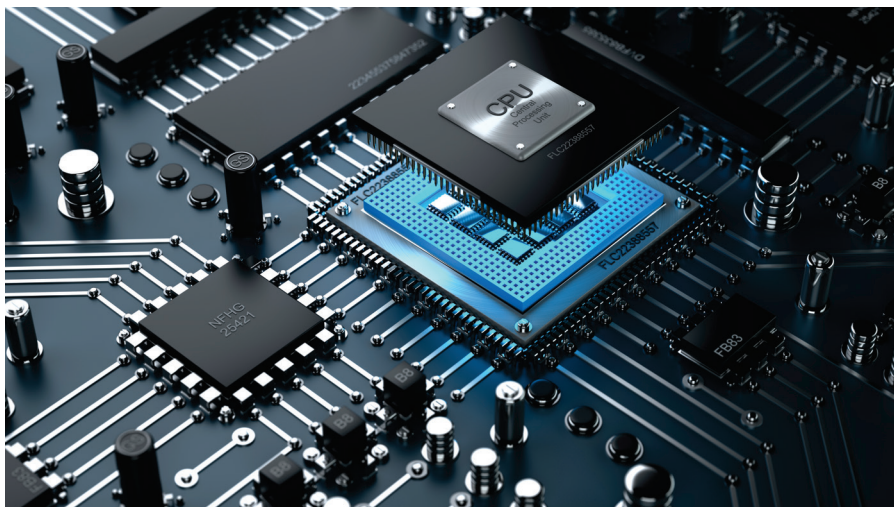
**Christian Gastón Palmaz**  
President, CEO, and Principal  
Vactronix Scientific

In what way are you an entrepreneur or inventor?

**Aaron Birt:** As an entrepreneur, co-founder, and CEO of Solvus, I've had essentially just one job for the last five years: Create a vision of the future and guide our team to achieving it. We've had to actually invent what entrepreneurship looked like along the way. Our business model is totally unique in the field, and it's something for which we are particularly proud. Beyond the unique "end-to-end venture building" model that we've developed, each of our areas of business in and of itself requires extensive invention and innovation. From novel powder materials to advanced materials processing to unique data storage methods, our team had to invent our way through every technical and business problem that we've ever faced.

**Ho Lun Chan:** My personal story is best described by my childhood fascination with abandoned electronics. I was born and raised in Hong Kong where hundreds of abandoned machinery parts and electronic devices were being hoarded and sold per unit weight weekly in an open street market. For me, it was a cluster of treasures. During my teens, I designed a flashlight that could power a LED light for a couple minutes with a simple pulling of a string and a metal box that converts waste heat into thermoelectricity for incineration applications.

In my second year of college, I was encouraged to participate in the Cal Poly Pomona NSF I-Corps program, which is accelerated training that prepares scientists and students to commercialize their ideas coupled with generous financial support. During this project, my friend Janam Dave and I designed a rapid labeling device that can improve labeling speed, accuracy, and traceability for high-throughput laboratory experiments in the biomedical industry. We also interviewed corporate executives, potential customers, and conference exhibitors to find beta testers and learn how to be a good inventor and entrepreneur. We eventually



MesoGlue, co-invented by Hanchen Huang, can be used for die bonding.

succeeded in applying for several project grants and collaborating with companies willing to test our product.

**Frauke Hogue:** After working for a fastener company for 10 years, I started my own consulting company in metallography. As far as I knew, this had never been done before. Through ASM, I knew several organizations in the failure analysis field who needed metallographic services but did not need a full-time metallographer. I did not want a full-time position because I had two small children at home and I wanted to spend time with them.

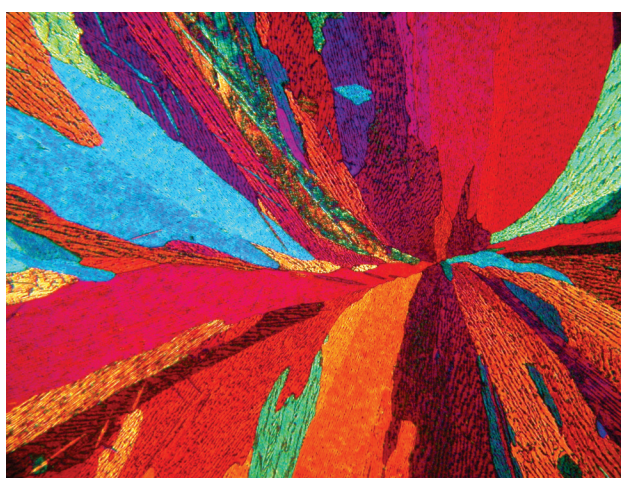
**Hanchen Huang:** Together with two former Ph.D. students, I co-founded a startup company, MesoGlue Inc. Our path is probably typical for many university scholars. We first discovered the scientific origin of why metallic

nanorods from physical vapor deposition are nano. Based on this discovery, we formulated analytical theories of nanorod dimensions and spacing. Guided by these theories, we experimentally synthesized the smallest and yet well-separated metallic nanorods through physical vapor deposition. Using these nanorods, we invented metallic glue that sets at room temperature but functions at high temperatures and we received a U.S. patent. MesoGlue Inc. commercializes the metallic glue for glass-metal bonding, thermal interface bonding, and die bonding.

**Mukta Kulkarni:** I am an entrepreneur and in a small way also an innovator. I am always ready to take on challenges to produce difficult castings or alloys. This has led to innovative development for many of our customers.

My company's focus has always been on developing new castings for new applications and innovating ways to achieve the results.

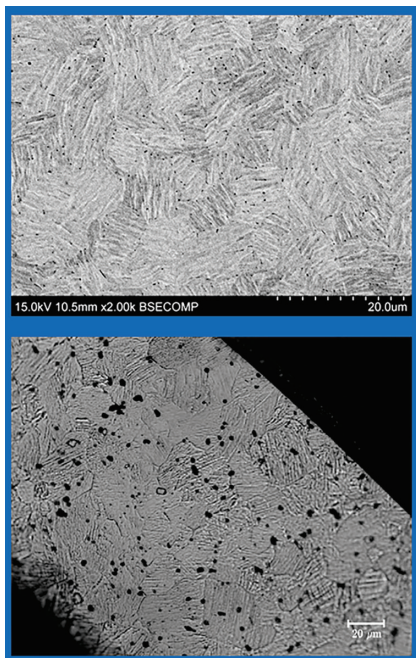
**Jean Mozolic:** I started my career in a rather standard way. In 1975, I graduated from MIT with a B.S./M.S. in materials science and joined the workforce as a sales engineer for Union Carbide Coatings Service. Over my 47-year career in the



Specimen of cast zinc, prepared by Frauke Hogue of Hogue Metallography, Pacific Palisades, Calif.

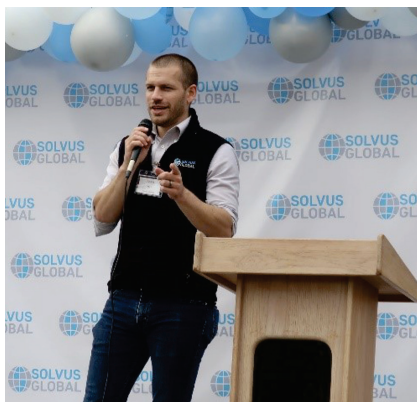
thermal spray industry, I rose through the ranks of sales and business management with my last corporate job as North American Business Manager for H.C. Starck. In 2006 when I parted ways with that company, I was at a crossroads. I could continue the path I had been on and get another job or I could go down another path. I chose the other path of starting my own consulting business with a focus on helping small to mid-size companies with their business expansion/business diversification plans in the thermal spray industry. It is now 2022 and I am still working, enjoying, and traveling the entrepreneur path.

**Christian Palmaz:** I founded Vactronix Scientific in 2016 with the goal of commercializing a new atomic additive



Per Christian Palmaz, PVD Nitinol (top) results in increased purity and improved microstructure compared to wrought Nitinol (bottom).

manufacturing technology the company developed, HE-PVD (high energy-physical vapor deposition). The cylindrical magnetron PVD tools that we design and build allow for net shape devices with high properties and tight dimensional tolerances. This disruptive technology allows a new era of “super materials” (focused on shape memory alloys) to be created and then fabricated



Aaron Birt, at Solvus Global's ribbon cutting event.

into higher precision devices enabling innovations across a range of industries from medical to aerospace. Vactronix's IP portfolio encompasses materials, devices, processes, and equipment patents. This landscape is covered by over 360 patents in 18 countries.

What is the biggest overall lesson you've learned in running a business or being an inventor?

**Birt:** People are the key to everything—this means it is critical to have the right team in place and to take care of them. But this also means you have to understand that removing one person from the team can help the whole team work more effectively. It's a unique balance of empathy for both the individual and the team, and the hard part is balancing both. This is why at Solvus, every pitch deck begins with the following statement: “Ideas are cheap. Execution is hard. People are everything.”

If we as entrepreneurs and inventors can begin to understand the shift in

the job market that is working to align the interests of investors, founders, and employees, then we can begin to craft business models and retention programs that deliver higher value for everyone involved in the process—instead of focusing on maximizing just one variable, often profit.

**Mozolic:** You are not alone. Your network, your colleagues, your friends, your accomplishments, and your reputation are all there to help. Just ask and share. You will be surprised by how many people will step forth to help you. Don't be bashful that you are starting a business as an entrepreneur or inventor. Shout it out to the world. There are so many ways to do this: social media, professional societies, publications, presentations, and patents. Be creative; be inventive. If you are too reserved to shout it out, hire someone to do it for you or train you to do it. Just make sure you know what your message is and how to effectively deliver it. It's all part of branding yourself and your business.

**Chan:** The biggest lesson I've learned is the profound importance of maintaining a sense of both reality and imagination when implementing a project as the leader. To run a business or be an inventor requires a totally different set of skills and interests. When a new, possibly groundbreaking idea was being discussed, it was easy to get transactional, and become managerial and corporate-like without a true understanding of what problem this idea could solve. But if we are only realistic, we become pedestrian and will fail. I believe that the ability to invent comes from a natural interest in creating, which can be perfected through STEM education.

## SMST ENTREPRENEURIAL WORKSHOP

A unique 1.5-day event for shape memory alloy (SMA) entrepreneurs across all fields, existing and emerging, will be held on March 14-15, 2023, in Fort Worth, Texas. The SMST Entrepreneurial Workshop will include the opportunity to: network with entrepreneurs, suppliers, and investors; hear from successful SMA entrepreneurs; learn about cutting-edge technologies and processes; gain connections to call on when troubleshooting and planning new products; and pitch your idea at the first-ever SMST SMArt Tank. Submission deadline is January 30, 2023. For more information, visit [asminternational.org/web/srst-workshop](http://asminternational.org/web/srst-workshop) or email [kathy.murray@asminternational.org](mailto:kathy.murray@asminternational.org).



Sustainability is a growth area for materials entrepreneurs.

From many failures, I learned to understand reality, take time and risk, then soar above the reality and do the necessary work to make an idea come to life.

**Kulkarni:** The biggest lesson I have learned is: If you don't challenge yourself in business somebody else will.

**Palmaz:** The biggest lesson I've learned is that simply making a better material that performs at a higher level or outperforms the status quo isn't enough in today's market environment. For the new material to truly disrupt the space, you have to deliver an end-to-end value proposition, not just to the customer directly using the material but all the way to the end user. In addition, we need to overcome assumptions with respect to the cost of the technology as well as reeducate our customers who are accustomed to a set of limitations that do not apply to our advanced technology.

What opportunities do you see for materials science entrepreneurs?

**Chan:** I believe that sustainability in materials engineering is of a great interest to materials entrepreneurs. Governments across the globe are striving

to reduce global emissions and achieve a net-zero economy toward the mid-21st century. To reach this ambitious objective, we have seen a substantial increase in the amount of research and entrepreneurship funding, either from government agencies or philanthropists from the private sector, supporting projects related to decarbonization, the circular economy, and sustainability. There is no doubt that materials science and engineering, due to its interdisciplinary nature, will play a key role in enabling this goal.

**Huang:** Through additive manufacturing, particularly with micro and nano scale control, it is now feasible to design materials with the desired properties and with the prescribed chemistry, structure, and morphology. This level of materials design will enable the invention of many more technologies, which entrepreneurs can then commercialize.

## CALL FOR INNOVATORS

IMAT 2023 is looking for entrepreneurs, startups, and venture capitalists in materials science. Do you have a new product, service, or technology you would like to showcase? Contact [kelly.thomas@asminternational.org](mailto:kelly.thomas@asminternational.org).

**Birt:** The opportunities are endless—from advances in agriculture to space and water to nuclear energy. Every single industry has a materials problem they are actively working to overcome. If you can combine intuition, advanced modeling, and advanced processing to solve a materials challenge, then you have the opportunity to forge a new business, or support an existing one. I think it's important to remember that entrepreneurship does *not* mean you have to start a company. You can be an entrepreneur in nearly any role. A “materials science entrepreneur” is given an objective and figures out a way to meet that objective no matter what limitations might be placed on them.

**Mozolic:** There are so many opportunities: reducing the planet's carbon footprint; climate change; transitioning from fossil fuels; battery development from Li ion to solid state and beyond; energy harvesting; modernizing the grid; harvesting people's motions i.e., walking on sidewalks that capture vibrational energy; smart clothing; installing solar panels, wind turbines, and shock converters on homes, buildings, sidewalks, highways, and automobiles; more effective desalination; more efficient primary metals manufacturing; expanding the use of composites and lightweight materials for transportation, drones, and military applications; enhanced medical implant designs; and improved robotics/bionics. I am excited about the work that is being done on all of these fronts.

**Hogue:** Right now, people are very willing to accept creative solutions to work situations. This is an ideal climate for entrepreneurship, but you must be creative and put effort into developing something of special interest.

How can ASM support innovators as they start and grow businesses?

**Mozolic:** Many innovators have absolutely wonderful ideas but may not have the experience for how to start a business. Introducing innovators to other innovators, business owners, and



3D printer education as part of a robotics lesson can spark a child's inventive spirit.

entrepreneurs within the organization would be of tremendous value. Success breeds success. Matching innovators with successful mentors would also be of value. The path of an entrepreneur can be lonely. Having a community of like-minded folks reinforces that you are not on this path alone and that we are all here to help one another whether we're just starting out or have been on the entrepreneur's path for decades.

**Birt:** This is an important topic—as we work to democratize research, innovation, and entrepreneurship, we need to celebrate all of the innovators of our era. But we *cannot* exclusively celebrate the successes, we also need to celebrate the failures. If ASM can share stories of success and “opportunities for learning based on our mistakes” across the materials industry, then we can begin to learn from one another how to innovate faster and more successfully as a group. There is so much room for innovation right now across space, climate change, and clean energy. We need to move at speed together in order to drive effectively toward a better world.

**Hogue:** ASM has accumulated an enormous amount of materials science information. This information can be accessed by members. Go to chapter

meetings and conferences, take classes, and connect with people in your field. Often at a chance meeting, a connection is made that will be very valuable in the future.

**Huang:** ASM meetings can be a platform to connect inventors and providers of new materials technologies and products with users, possibly through an entrepreneurship track or other methods.

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What advice do you have for the next generation of STEM entrepreneurs?

**Birt:** Chart your own course. There are so many pathways to successful entrepreneurship, whether it's being an entrepreneur within an existing organization, starting a venture backed company, starting a research and licensing company, or starting a bootstrapped company. Come up with a personal mission, the thing that gets you up in the morning to keep grinding at bringing your innovation to life, and relentlessly pursue that mission. Don't worry so much about how you're getting there, just focus on meeting that mission every day. Even if your company or

technology fails, you will have succeeded as a person, and that in and of itself is an accomplishment to be celebrated.

**Palmaz:** The best advice I have for the next generation is to avoid iterative thinking whenever possible. Although revolutionary ideas are rare, it's important that we constantly push ourselves not to accept the status quo simply because it is the standard or accepted practice. Additionally, don't be afraid to break out of the development bubble and reach for other approaches not traditionally found in your industry.

**Kulkarni:** Children should be taught how to enhance their creativity and should be allowed to innovate and experiment. Their minds should be free to imagine and think. Innovation will be the key to our future. Going forward, STEM will be in high demand, and this will also develop entrepreneurs. Creativity, flexibility, persistence, adaptability, along with knowledge and basic skills are all required for STEM and for entrepreneurs.

**Hogue:** Find something you love doing and get good at it. Then find out if somebody else can use your knowledge without having to invest a great deal of time in learning it. I really enjoy teaching and passing on the knowledge I have gained through the years. You do not have to be perfect. Admit if you do not know something; do not fake it. Connect with people.

**Chan:** As part of the next generation of STEM entrepreneurs myself, my advice is to prepare for the arrival of a transformative opportunity by always creating, improving leadership skills, networking, and most importantly, not succumbing to overconfidence. If there is something that sparks an invention or entrepreneurial spirit in you, don't let it remain on a piece of paper. Go talk to a mentor, call a company, or share your thoughts with your network of connections. Be bold in reaching out because sometimes it only takes one good conversation for an idea to take off. ~AM&P