



Ms. Catherine Kollhoff
Co-founder and CEO
NUMiX Materials, Inc.
Chicago, Illinois

Barriers to Entry in the Tech Industry for Diverse Entrepreneurs

October 3, 2019

Dear Senate Committee Members,

Thank you for the opportunity to testify before the Committee. Thank you, Senator Duckworth, for the time, interest in entrepreneurship, and hard work on behalf of the people of Illinois and the United States alike.

Starting a new business in the United States is difficult by any measure. Starting a technology-based business increases complexity. The challenges come from all sides. The oft-cited failure rate of 90% is discouraging. Yet a future with economic growth and prosperity depends on American entrepreneurship, and we need creative energy to come from all who are willing to take the risk to start a new enterprise. Despite this need, the World Bank ranks the United States a disappointing 53rd in the world for countries where it is easy to start a new business.¹ In this testimony, I will address three major barriers to tech entrepreneurship from diverse populations, detail my team's experience starting a technology-based business within the last two years, and offer solutions to remove barriers thereby promoting entrepreneurship for inclusive communities.

I am a co-founder and the CEO of an early stage, deep technology company, NUMiX Materials, Inc. My co-founders and I are developing more efficient ways to remove dissolved heavy metal contamination from water to enable better water treatment complemented by concentration and recycling of valuable metals within the domestic supply chain. Using the power of chemistry, we extract offending metals using less time, less material, and less waste than conventional processes. This problem affects every industry and every individual, and solving it in the face of a changing climate becomes increasingly important as we necessarily move toward climate resilience. A technology of this sort also improves the resilience of the U.S. supply chain against foreign powers by providing greater autonomy of resource within technology industries dependent on the use of heavy metals, such as semiconductors and batteries, which are not naturally occurring in the U.S. We approach our technical issues with optimism, though we have faced a number of challenges in our short life. While our path is unique, many entrepreneurs face similar struggles.

Access to capital is frequently cited as a major barrier. Research indicates that 81% of funding for new enterprises comes through personal net worth, family wealth, or connections to networks.² For individuals without access to these sources of funding, the barriers to any new business creation are high, let alone for highly specialized, deep science-based enterprises. Bias dictates that the

¹ "Doing Business," The World Bank. <https://www.doingbusiness.org/en/rankings>

² "Start Us Up: America's New Business Plan," The Kauffman Foundation. <https://www.kauffman.org/what-we-do/entrepreneurship/policy/americas-new-business-plan>

latter group of individuals will be left out. The Kauffman Foundation reports three reasons why 83% of entrepreneurs do not have access to a bank loan or venture capital³:

First, as small- and medium-sized banks have been decimated or absorbed over the past decade, large banks dominate the lending landscape. There has been a 41% decrease in the number of small community banks totaling under \$50 million in since the Great Recession of 2008, either through consolidation or closing. According to industry experts, the \$30,000 in average funds⁴ needed to start a firm does not hit the vast majority of banks' radars. Loans of around \$100,000 or less are hard for banks to make profitably.⁵

Second, the nature of many new businesses has changed from an asset-based model to a service-based model. These businesses do not have significant assets or collateral for banks to lend against but instead, are based on cash flow. As a result, these businesses do not fit banks' traditional underwriting models. Traditional lending models no longer fit today's startups: only 18 percent of businesses ever access a bank loan.⁶ For our company, access to sufficient capital in the first place is a challenge because we do not have sufficient company or personal assets to borrow against. Traditional bank loans are impractical at our stage of life.

Third, venture capital (VC) is a highly visible part of the growth of many well-known companies, yet the VC industry is focused on a small percentage of businesses with the potential for high growth: only 0.6% of businesses ever raise VC⁶. Furthermore, VC is highly concentrated geographically and demographically. In 2016, 78% of VC went to just three states (New York, Massachusetts, and California). Less than 1% of venture capital dollars went to rural areas.⁷ Less than 2% of startup financing went to women founders. Only 1% went to African-American and Latino founders⁸.

While venture capital may be a useful tool for a growth stage, the risks associated with game-changing business ideas in the physical sciences outside of the coasts in a predominantly women-owned company are not in line with risks typical VCs are willing to bear. For United States competitiveness, another huge problem is lurking: increasingly, large corporations are moving away from the model of in-house research and development budgets, selecting instead to outsource the risk to entrepreneurs and select only those technologies which have already seen some measure of success. The burden then falls to the early-stage company to cover the costs of scientific equipment, specialized scientist and engineer salaries, as well as business development. Tech entrepreneurs' access to the right capital at the right stage is paramount to United States competitiveness.

SOLUTION: We at NUMiX Materials have been fortunate to win support from the United States Department of Energy's competitions, such as the now-inactive CleanTech University Prize, and the

³ "Three trends that prevent entrepreneurs from accessing capital," The Kauffman Foundation.

<https://www.kauffman.org/currents/2018/07/3-trends-that-prevent-entrepreneurs-from-accessing-capital>

⁴ "The Use of Credit Cards by New Firms," The Kauffman Foundation. <https://www.kauffman.org/what-we-do/research/kauffman-firm-survey-series/the-use-of-credit-card-debt-by-new-firms>

⁵ "Making Small Business Loans Profitably," BAI. <https://www.bai.org/banking-strategies/article-detail/making-small-business-loans-profitably>

⁶ "Startup Financing Trends by Race: How Access to Capital Impacts Profitability." The Kauffman Foundation. <https://www.kauffman.org/what-we-do/research/2016/startup-financing-trends-by-race-how-access-to-capital-impacts-profitability>

⁷ "Venture Capital Goes Urban: Tracking Venture Capital Investment and Startup Activity Across Zip Codes." The Martin Prosperity Institute. http://martinprosperity.org/media/Startup-US-2016_Rise-of-the-Urban-Startup-Neighborhood.pdf

⁸ "Why so few Latino-owned businesses get venture capital funding," Octavio Blanco, CNN Money. <https://money.cnn.com/2016/04/12/smallbusiness/latino-venture-capital/index.html>

Argonne National Lab-embedded entrepreneurship program, Chain Reaction Innovations, which provides funding and access to laboratory space and resources for companies developing physical technologies from the bench scale to market-ready. We have participated in the hallmark National Science Foundation Innovation Corps program, which trains scientists on developing commercial opportunities for deep technologies. We have also received very early-stage support from philanthropic-backed organizations such as VentureWell. None of these granting organizations have taken equity in our company, unlike many accelerator and incubator models, allowing us to maintain control of our own company at its earliest stage and preserve valuable equity for future fundraising and partnership events. These funding opportunities range from \$2,000 to \$220,000, providing the seed capital to de-risk the physical technology and further develop the commercial opportunity. These programs are necessary for early-stage development but not sufficient for long-term growth.

SOLUTION: Sustain or increase funding for mechanisms that allow money to flow directly to early-stage companies rather than filtering it through incubators and accelerators which take an equity stake in an early-stage company.

SOLUTION: Eliminate zip code- and race-based influences on lending rates.

SOLUTION: To encourage science and tech-based businesses to form and stay in Illinois, provide matching state funds for SBIR recipients. While we have not received Small Business Innovation Research (SBIR) funding, it is widely recognized as one of the most valuable programs for developing science-based businesses, and we continue to put forward applications. To encourage inclusiveness in these funding opportunities, allow for a percentage of SBIR funds for business or commercialization salaries for women and underrepresented people.

Representation, mentorship, and education together form a second major barrier to entry.

Women comprise 47% of the workforce in the U.S., yet they hold less than 25% of the jobs in STEM industries.⁹ The gap widens at the top where women make up just 2% of tech CEOs, generally in software technology. In work compiled by Cynthia Macias for mHUB Chicago, it is shown that while the manufacturing workforce is comprised of 30% people of color and 20% women, only 15% of participation in entrepreneurial pipelines is comprised of minority groups.¹⁰ According to the U.S. Small Business Administration, Black-owned manufacturing firms represent 7% of all U.S. businesses, Asian-owned firms represent 4.3%, Hispanic-owned firms represent 10.6%; and veterans own 9% of all businesses. Additionally, minorities are nearly 40% less likely to own STEM-related businesses, and only 8% of all senior leadership positions in those businesses are held by minorities.¹¹ The share of small businesses owned by women increased to 29%, but significant growth opportunities remain for women entrepreneurs in STEM.¹²

⁹ "STEM Facts on Women and Girls," Million Women Mentors. <https://www.millionwomenmentors.com/facts>

¹⁰ Minority STEM Entrepreneurs. Office of Economic Research. U.S. Small Business Administration. Accessed December 14, 2018. https://www.sba.gov/sites/default/files/FIN_STEM_4_2016_0.pdf

¹¹ Minority STEM Entrepreneurs. Office of Economic Research. U.S. Small Business Administration. Accessed December 14, 2018. https://www.sba.gov/sites/default/files/FIN_STEM_4_2016_0.pdf

¹² Kymn, Christine. *Help Wanted: Seeking Women Entrepreneurs in STEM*. Brookings. December 8, 2014. Accessed December 15, 2018. <https://www.brookings.edu/blog/techtank/2014/12/08/help-wanted-seeking-women-entrepreneurs-in-stem/>

When the fraction of the entrepreneurial pool (i.e., educational, training, and work-experience typical in this sector) for women, African Americans, and Hispanics is compared to the observed venture capital and founder participation of these groups, each group has meaningfully and persistently lower representation than would seem appropriate given their proportions of those with requisite backgrounds to enter the sectors.

Recently in venture capital, more women from finance backgrounds have recognized the issues of representation and bias in the entrepreneurial pipeline and have stepped up to contribute their skills on the investment side. Their ability and willingness to take risks is applauded, and it is recognized they face some of the same burdens that woman and underrepresented minority entrepreneurs face, as well, as they seek to raise money from limited partners and champion the companies they believe in. While anecdotally there appears to be an uptick in women participating in venture capital, only 8% of partners at the largest VC firms are women¹³. The same trend is not true for African Americans. As Gompers and Wang from Harvard Business School found, “African American labor market entry participation has increased from about 11% in 1990 to 12% in 2010-2015. The share of undergraduate degrees being granted to African Americans students increased by more than 50%, from 6% of BAs granted in 1990 to 9.2% in 2010-2015. The pattern of African American entry into the legal and medical professions has not changed dramatically over the past 25 years, remaining around 5% in each profession. The rate of African American participation in venture capital and entrepreneurial sectors has not grown either. Strikingly, however, the rate is substantially lower than their participation in law or medicine, always less than 1%.”¹⁴

In my experience, even when minority-led funds exist, they are still managed by typical venture capital firms. In the private investment space, outsized returns are expected within the life of the fund, typically 10 years maximum. Compared to software companies, which can scale exponentially given the virtual nature of their delivered product, private investment is scarcer to come by for transformational deep science-based businesses. Of that private investment, we see only patient capital from philanthropic funds and wealthy individuals willing to invest in step changes that will promote resilience in the face of climate change and allow humans to sustain life on earth. By way of an example, as China will no longer take our “recycling,” what do we do with our waste at the end of its life? When we can no longer land apply the biosolids from our waste treatment processes because of PFAS contamination or lead content, what do we do with it? Where do the physical materials to manufacture the next generation of mobile phones and computers, IoT sensors, batteries, electrical systems, solar panels come from? How do we make food last longer? The goal of waste reduction and resource preservation is frequently squarely at odds with the revenue generation model for VC-backed high growth companies, as the sustainability field is seeking to decrease the overall materials consumed, not increase it by attractive multipliers year-over-year as VC requires. These step changes must come from paradigm shifts in the way we source, create, use, and dispose of physical materials, with chemistry at the very heart of our problems and our solutions.

This hopeful message is not an easy one to convey. While many hear “tech” and associate it with a more convenient way to order a car or a pizza, a new form of entertainment or personal care

¹³ “Why Women-Owned Startups Are a Better Bet,” Boston Consulting Group. <https://www.bcg.com/en-us/publications/2018/why-women-owned-startups-are-better-bet.aspx>

¹⁴ “Diversity in Innovation,” Gompers and Wang. https://www.hbs.edu/faculty/Publication%20Files/17-067_b5578676-e44c-40aa-a9d8-9e72c287afe8.pdf

product, or home delivery meal services, in our space, we view technology as chemical capabilities that can fundamentally alleviate human-made problems by changing the physical characteristics of how we live. If it sounds scary, it may be because “chemistry” has a bad name. But chemistry has always been at the heart of American innovation, from power generation to turn the lights on to life-saving pharmaceuticals to change how long we can live to soil amendments that make it possible for all of us to eat. It isn’t without challenges, as we’ve seen recently with Sterigenics and Purdue Pharma and other actors whose actions and subsequent inactions create a marketing problem for the chemistry world.

I chose chemical engineering as a career when I was eighteen, before I knew what it meant, because of effective marketing. On a college visit day, I had a chance to meet with the chair of the department, who asked my interests. I told him I wanted to save the world, full of the wonder and confidence that marks those years. I thought I would study environmental engineering. His response was, “You can solve problems in the environment once they're already out, or you can prevent them from happening in the first place.” This effective marketing strategy de-mystified chemistry in my eyes, turning it into a tool to use, whose limits must be understood and respected, but whose energy is unparalleled in our world. He reached me, and I’m in this position today because of that interaction.

Women and underserved communities may be facing a similar marketing problem concerning technical entrepreneurship, especially in the physical sciences and engineering. The problems available to solve may seem huge. Who can solve them? The answer is “not everyone,” but given the right measure of frustration with the status quo, technical understanding, and vision for a different reality, many more than are currently engaged could be addressing the weighty problems that face us all.

We are faced with challenges unique to the space in which we’ve chosen to operate. The difficulty is further compounded when looking at statistics for both funding and mentoring of women and others underserved today. I have been privileged to work with several mentors, each valuable in his own way. I would not be here with you today without that mentorship. But none of these can understand what it means to be called “hysterical” for having strong points of view, “crazy” for pursuing realistic goals and answers to societal needs, or “underqualified,” though I am an expert in multiple fields. Rising opportunities for women in software fields do add encouragement, though the cross-pollination of advances made in those tech fields with physical sciences and engineering is difficult, and the chasm is wide.

As the same study from Harvard pointed out, these problems share a common root. The reason is this, according to the research: People with experience mentor and give money to people like themselves, while those starting out do what they see people like themselves doing.¹⁴ In other words, we all live in bubbles — not just in our politics or our friendships, but also in our careers — and this shapes the ideas we form.

The pipeline issue starts in childhood education. Solutions for encouraging inclusive communities in technology-based businesses require better educational opportunities and systems. Starting with colleges and universities is not enough, building skills that profmote interest in business and technology must start in elementary school, continue through vocational and college education, and be fostered even in graduate and post-graduate arenas. In a recent study by the Kauffman Foundation, 60% of students leaving high school reported they felt the description “Prepared with

the skills to start a business" described them not too well or not at all well. In the same work, students, parents, employers, and other adults reported that more of a focus on "real-world" skills is the one thing they would change about how high school is taught in the United States. Cultivating entrepreneurial thinking at young ages has the potential to future-proof our economy and to provide inclusion in entrepreneurship¹⁵.

SOLUTION: Cultivate entrepreneurial thinking in education by including real-world problem-solving activities in U.S. primary school curricula, as well as financial planning, time management, and communication skills.

Finally, one of the bleakest barriers to entrepreneurship in the United State is **affordable health care**.

For our co-founding group, access to affordable health insurance has been a major issue. This phenomenon is referred to as "entrepreneurship lock."¹⁶ A medical emergency for an uninsured- or underinsured co-founder would spell the end of the enterprise. Some solutions exist. COBRA can be used if an individual is leaving another job, though the costs may be the entire amount of a startup founder's modest salary if they can even draw one. Thanks to the Affordable Care Act, individuals under 26 have been able to continue coverage under their parents' insurance, but that's not a lasting solution. For entrepreneurs with dependents, the resource-constrained company can't initially bear the expense of insuring the entire family. These factors severely limit the type of person who can engage in endeavors like ours. My cofounders and I do not have independent wealth. We have worked full-time jobs to maintain health insurance, limiting our ability to develop business. Further, when the company has sufficient resources to provide coverage, insurance providers often will not provide group coverage for fewer than four people. This limit means there must be a baseline revenue of approximately four full-time employees, fully burdened. To be competitive with the market for deep science and physical engineering salaries, that baseline is around \$750,000. Many deep tech companies will not see revenue on that order of magnitude for about five years. Without independent wealth, the healthcare system in the United States exists as a significant barrier to technical entrepreneurship.

SOLUTION: Provide health care coverage options for clusters of entrepreneurs, for SBIR or other federal funding recipients, or companies younger than five years old. Require accelerators and incubators receiving federal funding to offer insurance coverage to participants.

Among each of these topics, the research is published mainly by philanthropic organizations with some projects sponsored by the SBA. In many cases, the data are a decade old or more. To fully understand the issues and develop solutions, funding should be allocated to updating and coalescing research efforts across various groups of stakeholders.

In sum, I believe the major barriers to inclusivity in entrepreneurship are access to funding; representation, mentorship and education; and health care coverage. I ask to sustain or increase funding for mechanisms that allow money to flow directly to early-stage companies rather than

¹⁵ "Visions of the Future: Ewing Marion Kauffman Foundation Research Findings." The Kauffman Foundation. https://www.kauffman.org/-/media/kauffman_org/currents-redesign/2019/09/kauffman-visions-of-the-future-research-results-9162019.pdf?la=en

¹⁶ "Is employer-based health insurance a barrier to entrepreneurship?" Fairlie, Kapur, and Gates. <https://doi.org/10.1016/j.jhealeco.2010.09.003>

filtering it through incubators and accelerators which take an equity stake in an early-stage company by activating national science and engineering resources, such as national labs. I ask to eliminate zip code- and race-based influences on lending rates. I ask for matching state funds for SBIR recipients in Illinois. To encourage women and underserved populations to participate in these funding opportunities, I ask to allow for a percentage of SBIR funds to be used for business or commercialization salaries. To counteract biases in later life and business, I ask for specific policies to rethink the earliest stages of education to promote the real-world skills-based knowledge fundamental to entrepreneurship. Finally, to address entrepreneurship lock, I ask for coverage options for young companies, SBIR recipients, and clusters of entrepreneurs.

I thank you for this opportunity to share our story. I urge you to continue inviting experts to testify. I urge you to continue hosting focus groups with entrepreneurs to hear the issues we face. I urge you to continue listening to the people who are stubbornly focused on making dreams into reality and elevating those around them along the way.