# Faculty New Entrepreneurial Venture Opportunities (University Spin-offs) through the STTR Program

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**Abstract**

The STTR program is a nearly untapped resource that provides the opportunity for faculty members to develop commercializable inventions. The program is meant to provide funds that allow faculty entrepreneurs an opportunity to work with established small businesses or earlier stage university spin-offs to develop technologies originating in their laboratories. While typical basic science NSF programs solicit fundamental research proposals, the NSF STTR program solicits proposals to develop cutting edge technologies. The availability of such programs is key to grow new small businesses that lead to viable employers and contribute to the nation's economy.

This presentation will discuss the co-founding and growth of ALD NanoSolutions, Inc., a University of Colorado (CU) spin-off of nanotechnology developed in the Chemistry and Chemical Engineering Departments at CU. The importance of protecting valuable Intellectual Property will be discussed as will the importance of establishing a solid management team to run the small business. Discussions will focus on how to overcome challenges along the way with regard to funding issues and with regard to establishing customers and investors and in developing a marketable process/product. This presentation is a must for any faculty member interested in learning more about how to "spin-off" technology invented in their labs.

## I. Motivation

The motivation for faculty NEVs is threefold: (1) to provide job opportunities for recently graduated chemical engineers, (2) to provide funding opportunities afforded by the NEV operations, (3) and to see the results of one's research efforts put to practice.

Today, it has become increasingly difficult to place recent graduates in chemical engineering jobs. Recent graduates compete with the many temporary and recently displaced workers, many having numerous years of work experience. The number of chemical manufacturing jobs in the U.S. has declined by over 30% in the last ten years and the trend is continuing. It has become increasingly frustrating to deal with the lack of employers interviewing on campus. The employment of recent Ph.D.s with expertise in the area of the NEV is particularly desirable. Clearly, the ability to provide jobs for one's own students is a highly motivating factor for an NEV.

Although government funding of academic research has picked up in recent years, the success rate is still about 1 in 7 basic research proposals being funded. The success rate for SBIRs and STTRs is greater, typically on the order of 1 in 4. These higher odds are intriguing, although the faculty member needs to understand that such proposals are developmental in nature, rather than fundamental. Basic research proposals will not get funded. Proposals to SBIR/STTR programs need to identify the significance of the process or product for which funding is requested, the commercial potential, and a research path for process/product development to go from a research entity to a commercial product. While reviewers of basic research proposals are interested in seeing students funded, reviewers of SBIR/STTR proposals are interested in seeing practicing engineers and scientists funded. From the academic perspective, research associates are the most likely to be funded, not graduate students.

For faculty members who want more out of their research than published papers, the opportunity to see the fruits of their research efforts put to commercial use is the ultimate desired outcome. This is not an easy process and the path has many obstacles that need overcome. However, success has many ramifications. In addition to personal financial reward opportunities, the opportunity exists for the faculty member's research lab to benefit directly from royalty payments or equity valuations. Such success could dramatically reduce the effort the faculty member is required to put into typical academic proposal writing to support their university research.

It should be noted that the developmental efforts required for submitting SBIR/STTR proposals limit the amount of time that a faculty member can normally afford to write more "academic" types of proposals. In the past, such efforts have been considered less than "academic" and success did not receive the same kind of kudos as success for standard "academic" funding. However, the lack of reasonable university funding by the chemical industry in general and shrinking state budgets have forced universities to take a new look at the entrepreneurial aspirations of their faculty inventors. The day will come when issued patents and funds from STTR or SBIR subcontracts will receive the same amount of glory as published papers and funds from basic research grants. Universities are seeing more and more pressure to self-fund their activities.

## II. Intellectual Property

Valuable intellectual property (IP) is the key driver for most faculty scientist NEV's. In the early stages of the start-up, the IP provides the valuation that typically drives the outside interest in the NEV. For a typical faculty member, this is an unusual motivator. Faculty scientists are accustomed to publishing valuable research results as soon as they become available. The "publish or perish" mentality is paramount and an early to publish scenario is expected to provide for positive peer reviews relative to basic research proposal submissions. However, publication or presentation of novel findings will typically void international patent protection on any potential IP. In the United States, a patent can be filed within one year of the disclosure of the information.

A preferred scenario for the faculty inventor is to file a provisional patent application prior to any public disclosure of the novel results. A provisional patent application will

protect the IP internationally for up to a maximum of one year until a patent application is filed. A provisional patent application is inexpensive to file and relatively painless to draft since it can be the actual paper to be submitted for publication or the presentation to be made. Then, the faculty scientist has one year to use public presentations and publications to drum up interest for the concept. The filing of a provisional patent application also eliminates the strict requirement for a secrecy agreement relative to discussions with a third party of interest. For university research, the change in the patent law, allowing provisional patent applications, has been a significant factor in initial low cost patent filing

## III. Start-up Funding

A new company needs a tax identification number and "seed funding" to move ahead. A business lawyer can help with the corporate structure at relatively low cost. Getting funds to move the faculty NEV forward are more difficult and time consuming.

Start-up funds are difficult to obtain and a significant effort can be used to acquire such funds. The traditional start-ups in the past have relied on angel investors and then venture capitalists to provide start-up funding. An angel investor is typically a rich individual or group of individuals who has (have) an interest in getting in on a start-up company at the earliest stage when the valuation is the lowest. This scenario provides for the most risk, but also the most opportunity for wealth generation. An angel investor will typically provide something like $200,000 to $500,000 of initial investment and will expect a significant amount of equity in the company in return (maybe 50%). An angel investor will typically have the patience to work with the faculty NEV as the company takes root.

Venture capitalists (VCs) typically don't invest in seed stage funding of NEVs since this is considered too risky. However, if a company moves beyond the "seed" stage, usually provided by an angel investor, and if the technology looks promising, venture capitalists may be interested in investing. VCs will typically invest $1 million to several million dollars and will again expect significant equity (maybe 50%) in the company. VCs are typically organized groups of wealthy individuals whose sole interest is making money as fast as possible. One of the disadvantages of VCs is that their exit strategy is typically to generate a high valuation ASAP and to get out. VCs will normally come in and take control of the management of the company. They will look for huge markets and will typically direct the NEV to aim for the fences in an attempt to hit a home run. Smaller markets that might be very adequate to support a small company may not necessarily be in the interests of the VCs. If the faculty entrepreneur is interested at all in helping to direct the NEV, he (she) needs to avoid the VCs if at all possible.

An alternative mode for acquiring start-up funds is to "boot-strap" the new company using SBIR/STTR funds. Although this will take a considerable effort, it involves proposal writing, so most faculty entrepreneurs should be very good at this. Time will need to be taken away from typical "academic" grant writing and the objectives of the SBIR/STTR proposals (i.e. development instead of basic research) will be distinct from basic science proposals. An STTR requires interaction of the NEV with a university and so it is a very desirable path for an NEV which is a "spin-off" of technology invented at

an academic institution. The academic connection is required to submit the proposal and a certain fraction of the required work needs to be done by the university. The advantage of the SBIR/STTR proposal is that the research area of the proposal is typically well-aligned with the research interests of the faculty entrepreneur. In addition, no equity is lost in order to obtain the funding and so the faculty entrepreneur can maintain involvement in the decision making of the NEV (this can be good or bad).

In general, acquiring funding from angel investors and VCs is a distraction to moving the technology forward and significant time can be spent "chasing money". On the other hand, pursuing SBIR/STTR funding, although a slower process to funds, allows more sustainable involvement of the faculty entrepreneur in the operations of the company. It is also a more comfortable path for a faculty entrepreneur who is very familiar with the grant writing process. Typically, SBIR/STTRs involve technically oriented proposals, while angel investor and VC pitches involve more business oriented proposals. In the end, business activities will determine the success or failure of the venture, but the SBIR/STTR route provides a more comfortable setting for a faculty entrepreneur to move forward in the early stages of the start-up.

## IV. Management

An NEV will never succeed without a solid management team! In general, this is not the faculty entrepreneur, although it could be! The Chief Executive Officer (CEO) of the NEV could be the angel investor, if they have had prior business experience. No matter how solid the technical portfolio of the NEV is, a first class business management team is absolutely necessary for success. It is highly desirable that the CEO be someone who has had successful experience with previous start-ups. It is more desirable to have a CEO who knows how to "bootstrap" if need be, rather than a CEO who has been taken care of by some large company. The CEO's initial role will be to shore up university IP and to negotiate a license agreement with the university for the NEV. After that, the CEO's main role is to search for investment and partners to help commercialize the technology and to provide a continuous "sanity check" for the NEV in terms of sustainability. The CEO may also be the Chairman of the Board of Directors (BOD) for an NEV and will run BOD meetings.

In addition to the CEO, the NEV needs an experienced Chief Financial Officer (CFO) who handles all financial transactions, including business agreements and accounting procedures. The CFO should be experienced with proper accounting practices and is desirably a licensed Certified Public Accountant (CPA). It is highly desirable for the CFO to have financial connections with the small business world, including VCs and major companies. For NEVs, the CFO is the primary individual handling all audits that are required for government grants. Like the CEO, a solid CFO will keep the NEV on a strict budget and will protect the NEV from making significant financial mistakes.

For an NEV, it is highly desirable that the President of the company be a solid operations person with a good technical background in the area of the NEV's business. The President may also be the Chief Technology Officer (CTO), a role for which they may later be assigned if the NEV survives to the next stage. The early President needs to be

able to work with and through others and to successfully carry on the day to day operational activities of the company. The early President may be a Principal Investigator on SBIR/STTR proposals. They need to be able to hire employees and to direct these employees to get the required work done. The President will be the most important early stage member of the management team and needs to be someone that can be trusted to handle the many responsibilities needed for getting the NEV off the ground on a day to day basis.

In the end, the success of the NEV will really depend on the performance of the CEO, CFO, and President. In order to be taken seriously by potential investors and business partners, these three positions need to be filled by solid individuals that can operate as a well lubricated team along with the faculty entrepreneur(s) that is (are) providing the overall technical guidance of the NEV.

## V. Sustainability

In order to be sustainable, an NEV needs real customers who are willing to buy something that the NEV is making or licensing. Cash flow is a real issue once the NEV is "off the ground" and needs to pay employees, building rent, and utilities. Such funding for cash flow can come from outside investments in the NEV, royalties, sales or additional SBIR/STTR awards. While the overall objective is to generate sales or licensing, a path that requires additional SBIR/STTR awards is inevitable for the early stage NEV. The pressure is on for the faculty entrepreneur and management team to sustain the company and the employees. While additional SBIR/STTR funding is inevitable, the NEV needs to avoid becoming an "SBIR house" where the sole purpose is to live off government grants doing research. A good management team will prevent an "SBIR house" from developing. Universities that spin-off NEVs are very much against "SBIR house" mentality. They want to see sustainable companies develop that are actually selling a product.

Generally, the NEV will focus on developing commercial processes/products, while the faculty entrepreneur is focused on developing improvements to the base IP or new IP that will help sustain the company in the future. This kind of scenario is one where the faculty entrepreneur is an active participant in helping to direct the company's activities. Such a business scenario runs counter to typical business operations run by VCs. However, it is clear that university spin-offs in which faculty entrepreneurs take a real interest in the operations of the NEV provide a unique framework for success that is quite different from the typical VC lead scenario. The NEV can benefit from low cost subcontracts to the faculty entrepreneur's lab to do research, especially if the IP license from the university to the NEV allows for exclusivity for IP improvements. In addition, the NEV can screen potential new hires via their support of research in the university. Conflict of interest issues need addressed early on and are a big part of the NEV/faculty entrepreneur relationship.

## VI. Exit Strategy

The management team, particularly the CEO and CFO, will have a clear idea of the exit strategy for the NEV. In general, this will be discussed with all individuals holding

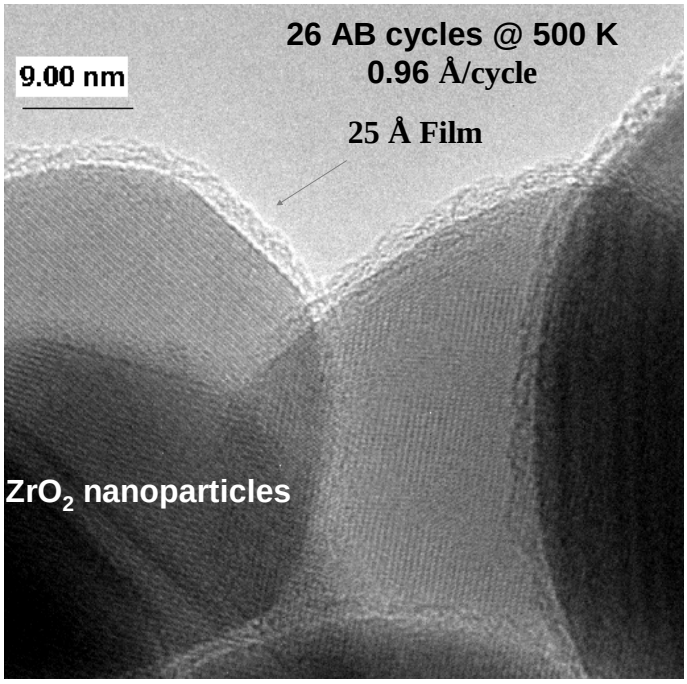
significant equity in the NEV. A likely exit strategy will be the sale of the NEV to some large company that is interested in the NEV's technology. Although unlikely, another exit strategy is an Initial public Offering (IPO) of the company. For early stage NEVs "bootstrapping" with SBIR/STTR grants, the exit strategy seems too remote to spend much time on. Nonetheless, successful NEVs will routinely be approached by larger companies interested in partnering with them to develop technologies of mutual interest.

**VII. ALD NanoSolutions, Inc., an STTR Bootstrapped NEV Example**

ALD NanoSolutions, Inc. was founded in 2001 by faculty entrepreneurs Prof. Alan Weimer (Chemical and Biological Engineering) and Prof. Steven George (Chemistry and Biochemistry), Dr. Karen Buechler (President and CTO) and Mr. P. Michael Masterson (CEO and Chairman) in order to commercialize Atomic Layer Deposition (ALD) technology to solve materials problems in a wide range of industries. Novel know-how and IP (U.S. Patents 6,613,383; 6,713,177; U.S. Patent Application 60/306,521; five additional pending patents) developed in the George/Weimer Laboratories represents the technology foundation for this commercial effort. The broad-based proprietary technology (process and composition; applications) allows generic primary particle (Particle-ALD$^{TM}$) and polymer (Polymer-ALD$^{TM}$) surfaces to be functionalized using ALD to deposit nearly perfect ultra-thin inorganic films with thicknesses controlled to within ~ 0.1 nanometer (see Figures 1).

**Figure 1**

**BN deposited by ALD on 50 nm $ZrO_2$ particles**




Faculty entrepreneurs, Prof. George and Weimer, filed the original broad-based Provisional Patent Application in 1999, prior to any public disclosures of the technology. Prof. Weimer is an expert in particle processing and reactor engineering. Prof. George is an expert in ALD. Prof. Weimer and George then contracted Dr. Karen Buechler, a postdoctoral Research Associate at the University of Colorado, to serve as President and CTO to run the day to day operations of the early stage company. Dr. Buechler is a

domain expert in fluid bed processing and materials science. In addition, Professors Weimer and George and Dr. Buechler then approached Mr. P. Michael Masterson to serve as CEO and Chairman. ALD NanoSolutions, Inc. was subsequently founded. Later, Mr. Robert Morgan was named CFO. This solid management team is a key asset of the NEV. The credibility of the NEV with investors and materials partners is a result of having this management team in place.

Mr. Masterson has been an entrepreneur for over 22 years. In addition to Mike's current responsibilities as the Chairman and CEO of ALD NanoSolutions, Inc., he is an advisor to Flagship Ventures and Science Futures, Inc. Prior to co-founding ALD NanoSolutions, Inc., he was Venture Partner at Flagship Ventures and, before joining flagship was CEO and co-founder of KMI/Parexel (NASDAQ: PRXL). In his early career, Mr. Masterson held technical and management positions with DuPont, Pfizer, and Procter & Gamble. Mr. Masterson holds a B.S. in chemical engineering from the University of Massachusetts and a M.S. in chemical engineering from the University of Colorado. In addition, he has completed Owners/Presidents Management (OPM) Program at Harvard Business School. He is a licensed PE in Texas and Massachusetts.

Mr. Morgan has more than 15 years of senior management and leadership experience in entrepreneurial technology companies. He has founded or played a role in launching more than a dozen venture-backed companies. He is a former Senior Vice-President of Flagship Ventures. Earlier in his career, Robert was the founder and for six years was a principal of a business consultancy specializing in providing strategic, operational and finance related services to entrepreneurial companies. In addition, he spent the first seven years of his career in public accounting and served as a Manager in the Small Business Group of Price Waterhouse, Boston. Robert is a CPA and received his B.S. in Accounting from the University of Massachusetts, Lowell.

Mr. Masterson negotiated with the University of Colorado and arranged for exclusive rights to practice and to license the base IP and to have exclusive rights to all non-3$^{rd}$ party future improvements coming out of the George/Weimer labs. Dr. Buechler and Prof. George and Weimer wrote and submitted STTR proposals in order to launch the company via a "bootstrapping" mode. The Company has been awarded five Phase I STTRs over the past three years and has successfully converted all completed Phase I research to Phase II funded projects.

In addition to the STTR grants, ALD NanoSolutions, Inc. has an un-named Fortune 500 materials partner that has invested in the company and is supporting research projects directed to technology that they intend to commercialize in their product lines. Additional fortune 500 companies are currently negotiating R&D contracts in their area of interest with the intention being to commercialize the technology at their facilities. In addition to these materials partners, ALD NanoSolutions, Inc. is developing high valued, low volume products that they intend to produce themselves should markets develop. In general, the research supported by the STTRs is further supported by other companies interested in the Particle-ALD$^{TM}$ process. ALD NanoSolutions, Inc. may also elect to manufacture themselves in highly specialized areas of R&D.

## VIII. Recommendations

The STTR program provides an opportunity for faculty entrepreneurs to start to develop commercializable technology invented in their laboratories. IP needs to be developed and protected as this is the primary asset of any "bootstrapped" NEV. A solid management team needs to be put in place if there is to be any possibility of commercial success. Partners need to be found to help develop processes/products for manufacture.