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The Hidden Gold within Applied Material Science

by: Sean Foote, Labrador Ventures – July, 2005

Though potentially capital intensive and time consuming, applied material science startups often yield 'extreme competitive advantage' not found in other young companies.

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As seen in the...

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They don't call it *Silicon Valley* for nothing. Indeed, the place was literally built on the stuff. Yet, for one stretch of dirt so weaned on a single material – to the point where all chips, computers and internet websites simply wouldn't exist without it – there still exists a curious lack of innovation in what one can do with silicon itself. How to grow it, glue it, fuse it, shape it, cut it, coat it and bond it. That's where IMI steps in.

Integrated Materials Inc., a Santa Clara, CA-based company (and Labrador Ventures-backed portfolio company) is a silicon-specific materials science startup that's helping boost the manufacturing efficiencies of the semiconductor industry's furnaces and clean-room processes. It's a wide open marketplace with few competitors, where the company has designed, developed and produced an extensive line of all-silicon structures – including towers, injectors, pedestals, tube liners, platens and other products – essential to the manufacture of integrated circuits at the lowest cost possible.

It's a field where IMI's extensive industry knowledge, domain expertise in silicon, and patents give it, and it alone, what we call 'extreme competitive advantage.' And for investors in applied material science companies, gaining 'extreme competitive advantage' is what it's all about.

The process works something like this:

According to Tom Cadwell, CEO of IMI, "There's a huge market ripe for expansion in what you might call second tier science," referring not just to the original benefits silicon has offered the semiconductor industry as a pure conductor of electrons, but also to new ways in which technology will help expand the use of that silicon in making the semiconductor industry more efficient. According to Cadwell, if a company can figure out a way to fuse silicon together such that silicon parts stay stable and ionically clean at high temperatures, there are innumerable ways chip manufacturers can improve on their production yields and, thus, lower their costs of production.

IMI has literally become one of the first companies to develop such fusion techniques and, in doing so, offers a perfect example of the rewards and competitive advantages seen by investors in materials science startups. It is quite literally building better mousetraps.

A League Of Their Own

Such material science startups are not easily born – nor built, however. There exist serious challenges investors and entrepreneurs must first face, and accept, before heading down this road of 'hard science.' Chief among such challenges is the very real difficulty of developing materials with the potential to be *extremely competitive*; in other words, materials that are so unique in their structure, or within their handling and manufacturing processes, that few if any other companies or scientists could duplicate the efforts that created them in the first place.

"With a software company you have a visible product though not a tangible one, the scalability is high and [you have] the ability to test products quickly, all of which make them attractive," says Cadwell. "With materials companies, all cycles take longer, testing takes longer, customer qualifications take longer, and equipment and basic materials are more expensive. Yet, because it takes a lot of time and money, it then becomes pretty hard to knock us off."

Indeed, though good material science companies are few and far between – as are specialized material science venture investors – the ones that do exist can be unique investment opportunities with distinctly unique competitive advantages in their industries. Rob Lachenauer, CEO of Geo2 Technologies, a Boston, Massachusetts-based developer and manufacturer of substrate materials for catalytic converters, would agree. Geo2, like most material science startups, spent years simply figuring out the best chemistry to base its substrates on – substrates that could catch the most particulate emissions set loose on the environment from diesel or gasoline powered engines. Years were invested before Geo2 could even determine whether its substrates might be produced cheaply, efficiently and with enough durability to withstand the quality controls of the automotive industry, let alone adhere to the regulatory requirements of the EPA.

"The companies that get into material science usually require a heavier capital investment, but that yields its own rewards. Remember, this is an expensive game to play and it's not like we can just get a

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couple of guys in India to write code for us and that's it," says Lachenauer, acknowledging the company has at least 6 months of product testing and then another 6 to 12 months ahead of it before signing licensing agreements with major customers. "Yet, you can really catch people by surprise if you indeed have a better mousetrap."

So what makes Geo2's, or any material science startup's, mousetrap that much better? Lachenauer has his list: "First, do you know your core chemistry and are you in control of that chemistry? Second, can you make a lot of what you're trying to produce and can you make it of a very high quality and cheaply – and that's a tough nut to crack. And third, at least for us, we want to get to 50 patents. With 50 patents we definitely have something."

It's this promise of the "better mousetrap" – or rather the notion of an extreme materials science breakthrough – that could prove extremely lucrative for investors choosing to play in this space. In Geo2's case, it's a catalytic converter that can make every car on the road a Zero Emissions Vehicle (ZEV) according to Federal emissions standards. For IMI, it's a 2 to 5 percent yield improvement in semiconductor fabs – an industry where manufacturers gain millions of dollars for every tenth of a percent in improved yield – which could prove to be their own path to riches. In each case, and others, it's clearly a 'high effort, high rewards' scenario for early stage venture investors.

Putting A Premium On Angels

Because material science technologies do not reveal their secrets quickly, seed stage investors must be careful in considering not only what technologies to invest in, but when in the development cycle to invest. Put another way, one must ask the question: Is this an investment in "applied materials" with true commercial applications, or an investment in "materials science" with open-ended, yet still largely undefined, possibilities? Answer this question correctly and investors can enjoy competitive advantages for years to come. Answer it incorrectly and you're in trouble – you've invested in nothing more than a mere science project.

The parameters for investing can thus be fairly easily defined: If it's going to take 3 to 5 years before the first dollar of revenue, that's simply too long. And if the company can't get to revenue within 6 months to a year, or if it can't get to revenue with the dollars first put in, it may not be worth the investment. If a startup can surpass all of these hurdles and thus distance itself from existing technologies, the barriers to entry created by entirely new material science companies are usually extremely high.

It's for this reason that Lachenauer himself was just as careful picking the company he wanted to lead as investors should be in picking companies to support: "I didn't want to get involved in a nano type of thing. I wanted something where we derived our product from other applications and customized it. Then we'd at least know it was workable." What Geo2 also has is something that can be particularly critical to material science startups – a healthy base of deep pocketed angels. The company has already raised $8 million over the course of two rounds through purely angel funding and expects that it may continue to raise an equal amount from its angels until its product is ready to ship in 2007.

Cadwell, with IMI for only a year and a half, equally acknowledged that because the company was self-funded in 1998 and 1999 and was then run on fumes with modest amounts of angel funding from 2000 to 2003, it was able to solidify its product in the hands of customers before seeking true venture money. Even then the venture community was skeptical of such *meat and potatoes* technology.

"At first they were intrigued with the concept but without a management team they weren't interested. When we finally had a management team, they then looked at the risk/reward tradeoff as they would with any other company. What was the market opportunity for the prospective development and was the market truly there? What's the speed of introduction, how long would it take to get to market and first revenues? Was the technological proposition sound from the customer perspective? And how realistic were our financial calculations and how much did we really think it would take to make this thing go?"

For IMI, all of those questions were answered this year and the company is now shipping product to customers. For another startup, Ribbon Technologies International, that process has only just begun. In fact, Ribbon, a thin film silicon crystal technology company hoping to replace traditional silicon growing processes, is in the classic bind facing any applied material science startup – it must first raise initial angel money for development, a major portion of which (at least $500,000) will be spent only on materials and equipment before any money can be spent on hiring engineers.

"The business plan calls for $3 million in funding and we've already obtained 6 patents on the laboratory process, but we must now prove we can do this with commercial scale machines," says David Mark, CEO of Ribbon Technologies. What Ribbon has is a deep level of domain expertise in the form of Dr. Blyle, a former scientist with General Motors, who has been working on this technology for 20 years. What it faces is at least 30 months until it begins generating significant cash and a list of potential investors that would rather see a commercial scale machine up and running before risking their venture money. In other words, Ribbon is trying to move from "science" to "applied material science".

If Ribbon Technologies can move forward on its own in much the way IMI and Geo2 have done, it's likely that it too could enjoy 'extreme competitive advantage' which makes investing in this space so unique. That's not to say the funding and technology hurdles do not remain high – if not higher than most any other area of early stage investing. But if companies like Ribbon can prove the physics and viability of their future technology solutions, or if companies like Geo2 can revolutionize auto emissions, carefully investing in these material science startups could indeed offer "extreme" rewards.

This is one in a series of monthly columns on seed and early stage investing that Labrador Ventures was selected to contribute to the *Venture Capital Journal*.

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