Nanomaterials, Nanofibres and Commercialisation

by Dr. Rainer Harms, Gerard Cadafalch Gazquez, Steven Walsh

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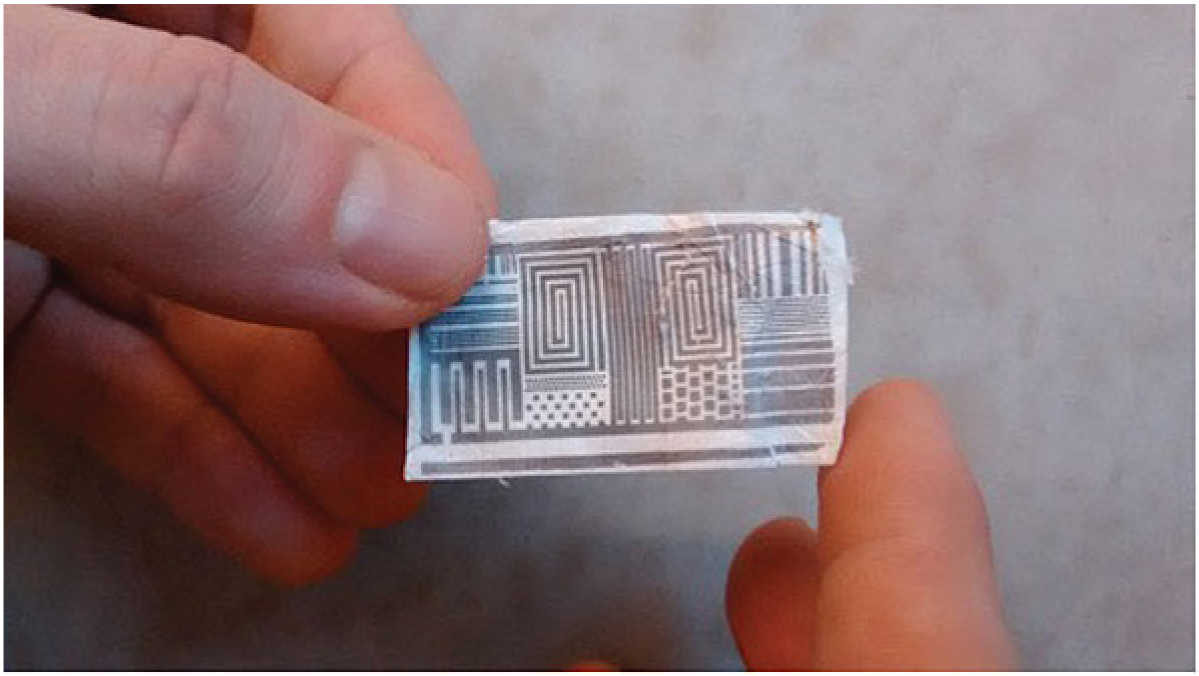

Figure 1. Eurekite's Flexible Ceramic Micro strip.

	Flexible PCB	Ceramic PCB	Flexible & Ceramic	Value
Flexibility	✓	✗	✓	Elastic Modulus = 1MPA >2000 cycles of 45° deflection
Thermal Stability	✗	✓	✓	Continuous operation >700 °C Maximum temperature not determined
Thermal Conductivity		✗	✓	~ 1.3 W/cm K
Density	✓	✗	✓	0.06-0.09 g/cm³
Dielectric Strength Dielectric Constant	✓	✓	✓	8-12 MV/m 2
Multilayer	✓	✓	✓	Each layer can be down to 25 μm
Price	✓	✓	✓	Comparable

Table 1: A comparison Between Flexible Ceramic PCB and Traditional PCB.

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Nanomaterials based technology is one of the 21st century's advance manufacturing techniques that have the ability to change the way industry's compete and ultimately the way we live our lives. Nanomaterials technology have been linked to advanced materials with positive performance attributes such as; temperature resistance, physical size and durability, pressure resistance, generation of high surface area platforms, and a variety of electrical, biomedical and optical properties to name only a few. These unique physical properties make them desirable to may industries. Investment in nanomaterials and nanofibre technology has been intense in a variety of industries such as the aeronautical, chemical, energy, electronics, filtration, construction, medical therapeutics, medical diagnostics, aerospace, and textiles is at an all-time high. There are differing types of nanomaterials and nanofibres including; carbon, ceramic, numerous material composites, glass, cellulose based, polymeric, and other materials. The global industry sales compounded annual growth rate is estimated to be from 25% to 45% depending on type of nanomaterials over the next five years. Yet despite this outlook many feel that the application of this technology is not growing fast enough but the types of products that many nanomaterials based companies make has recently changed.

The nanomaterials application space is ubiquitous and the cost issues in manufacturing nanomaterials had limited its commercial advance. Some say that advanced nanomaterials technology was hampered by its history of being an "Answer is search of a problem." Indeed one subset of nanomaterials, nanofibre research has a much longer history than believed with research being reportedly performed from the 1930's with few commercial product typologies until the 21st century.

There was a seed change in nanomaterials and nanofibre solutions. The 21st century saw these manufacturers improve manufacturability and cost and move toward making higher valued structures. We describe specifically how ceramic based nanomaterials and nanofibre manufacturers have created value. Specifically how these firms are utilizing ceramic nanomaterials to develop the next generation platform product for industries that see the potential in advanced nanomaterials and nanofibres. One of these companies is Eurekite. They are developing next generation products for the automotive and electrical marketplaces. They and other ceramic nanomaterials and nanofibre producers are now creating and emphasizing value added materials products.

These firms are searching for product platforms that that fit in to system integrators new platform development activities. One device from Eurekite is a flexible substrate micro strip. Their micro strip is a type of electrical transmission line used to convey microwave-frequency signal. They see this platform as a next generation method to build microwave components such as antennas, directional coupler, filters or power dividers. They are many advantages derived from Eurekite's ceramic nanomaterials based micro strip. As a direct substitute to traditional products the Eurekiute product has advantages which include size reduction, lighter weight, capability of forming conformal devices and lower cost of manufacture than current technology produced components.

Performance benefits include ceramic micro strips have better dielectric properties and can withstand high power applications. The dielectric constant of the flexible ceramic is 2 (at 10 kHz) and the dielectric loss of the material is estimated to be lower than the one of standard ceramics. The material can be used in high power applications due to high thermal resistance and heat dissipation properties. Please see Eurekite's Nano Fibres Micro strip in figure 1 one below.

Similarly Eurekite and other ceramic nanomaterials and nanofibre manufactures are addressing the next platform production in the automotive and truck building industry. Here they are developing a like product to that of above but developing it as a flexible circuit board. Advanced ceramic nanofibres and nanomaterials are being used to develop a flexible ceramic Printed Circuit Board (PCB), merging the flexibility and lightweight of a polymer and the temperature stability of a ceramic. The resulting product provides high resolution conductive patterns. The flexible ceramic PCB offers a low dielectric constant while keeping a relatively high dielectric strength. Moreover, the heat conductivity of the present material is superior to that of standard ceramic PCBs. In table 1 below we show the comparison between traditional PCB, Flexible and Flexible and ceramic PCB being developed by Eurekite.

Ceramic nanomaterial manufacturers like Eurekite have moved from making replacement components to manufacturing next generation platforms with superior performance measures.

Gerard Cadafalch Gazquez is the CEO of Eurekite and he studied chemical engineering at University of Barcelona, Spain. He completed his master thesis at the membrane technology group of the University of Twente. He has initiated a PhD at the Inorganic Materials Science group of the University of Twente. His PhD is focused on the fabrication of ceramic micro and nanomaterials. He has a professional background through working in chemical labs of companies such as Miguel Torres and Cargill. He is an active board member in many different associations.

Dr. Rainer Harms is an associate professor at Nikos, University of Twente. He is head of Research for International Entrepreneurship. He is an area editor for multiple entrepreneurships journals. His research area interests are entrepreneurship with a focus in technology entrepreneurship, firm growth and innovation management. He is connected to many nano technology research activities including MANCEF's series of technology roadmaps and landscapes.

Dr. Steven Walsh is a distinguished professor at UNM where he also holds the Regents professor at UNM's Anderson School of Management. He also is the Institute Professor for Entrepreneurial Renewal of Industry at the University of Twente. He has many business service awards, including the Lifetime Achievement award for Commercialization of Micro and Nano Technology Firms from MANCEF. He has also been named as a Tech All Star from the State of New Mexico Economic Development Department and has been recognised by Albuquerque the Magazine as a leader in service to the economic community. He is a serial entrepreneur who has helped attract millions of dollars in venture capital to many firms.

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