

**New York State  
Environmental Investment Program  
Research Project Summary**

**Graphene Devices, Ltd.**

**Project Background**

Graphene Devices, Ltd.(GDL), founded in 2009, is an enterprise spun out of the State University of New York at Buffalo (UB). Graphene was first isolated in 2004, but its commercialization only began in earnest in the last 5 years. Graphene is a substance made of pure carbon, with atoms arranged in a regular hexagonal pattern similar to graphite, but in a one-atom thick sheet [www.graphenedev.com](http://www.graphenedev.com). Graphene has unique electronic, thermal and physical properties which are enabling the creation of a new generation of products. Pristine Graphene is as electronically conductive as copper. It can be doped and or coated for use in electronic devices such as transistors, batteries, ultra capacitors and sensors. It is also one of the strongest materials known. This property has become important in the development of new lightweight high performance composite materials.

GDL has invented and created intellectual property for a variety of its own graphene technologies called GRIDS™ (Graphene Intermediate Dispersion System). GDL is focused on the development of low cost manufacturing methods for graphene dispersions and its surface functionalization. The technology goal of GDL is to optimize the suspension and dispersion of its proprietary graphene in various liquids for ease of incorporation into a variety of materials and composites. Development of graphene inks, polymers, and energy storage device components have been underway since GDL's inception. These efforts have been supported by the UB CAT, NY State, and Federal funding.

The business objective of GDL is to build a company with over \$30 million of total revenue by 2016. GDL will not sell graphene, but will sell GRIDS™. They are the building blocks to the formulation and fabrication of GDL's proprietary conductive coatings, ink precursors, and energy storage composites. GDL material developments will be targeting electronic devices, and a specific focus on clean technology that improves energy efficiency and energy storage.

**Project Description**

A main challenge to manufacturing graphene into GRIDS™ is the development of a high throughput, controllable process that will provide materials to satisfy high volume manufacturing activities. Before this project, no process existed to address this need without using acids and toxic chemicals. Many of the present processes used to generate graphene NanoSheets require strong caustic agents and hydrazine hydrate. Hydrazine is highly toxic and dangerously unstable and explosive; it is usually handled while in solution for safety reasons.

The purpose of this research project was to enable GDL to produce, in a safe, cost effective manner; modified graphene based GRIDS™ that can be used in a variety of applications. GDL's proposed process would remove hydrazine and all caustics from the production process as well as reducing the use of any remaining toxic materials. At the outset of the project, graphene GRIDS™ were made in laboratory scale small batch processes that yielded ~50 grams/week of product. The target was a continuous process designed to yield 10 kilograms of product per week and scalable to produce larger quantities as necessary.

**Project Results**

This project showed that it is technically and economically feasibility to develop a continuous, safe, synthetic, scalable prototype manufacturing process for the manufacture of chemically modified GRIDS™. GDL achieved the ultimate goal of this effort, to remove the need for hydrazine and caustic chemicals in the manufacturing process. An additional success was scaling the process to over 1 metric ton per annum (over 20 kg/week) by the use of a flow through technique, while reducing costs and remaining a green process, free from dangerous caustic chemicals and hydrazine.

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<b>Contractor:</b>	Graphene Devices, Ltd.	<b>NYS EIP Investment:</b>	\$200,000
<b>County:</b>	Erie	<b>Contractor Match:</b>	\$222,890
<b>ESD Region:</b>	Western New York	<b>Total:</b>	\$422,890
<b>ESD Contact:</b>	518/292-5340	<b>Completion Date:</b>	December, 2012