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## Advanced Applications for Inorganic Nanomaterials

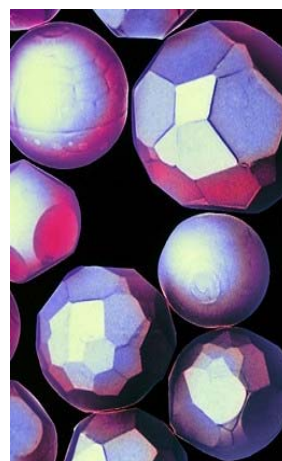
Dr. Paul Reip

Director – Government and Strategic Programmes



### Intrinsiq Materials Ltd

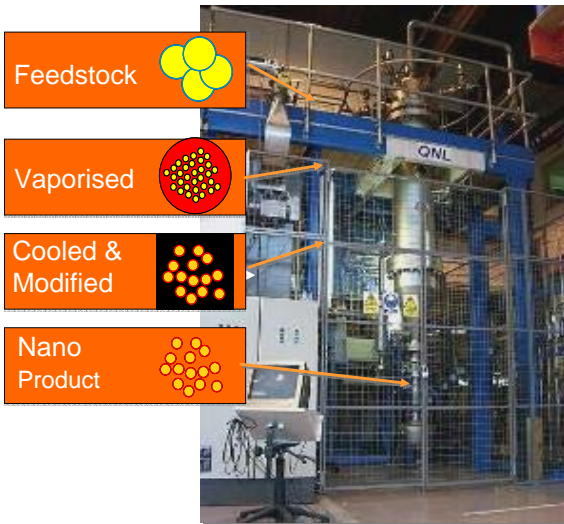
- Leading Nanotechnology Company with a broad set of international customers and partners.
- Powerful Platform Technologies
  - Novel tool for development and manufacture of novel nanomaterials
  - Controlled release of high value actives
  - **Novel antimicrobial and antiviral materials**
  - **Printed Electronic solutions**
- Considered by HSE/HSL as leaders in safe inorganic nanomaterial production, handling, packing and shipping.
- Substantial IP portfolio of 34 patent families







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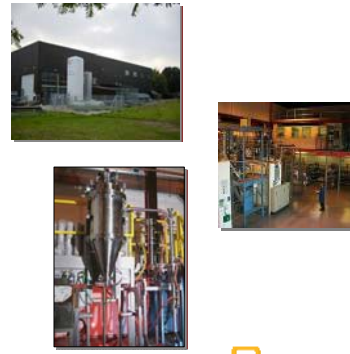


# IML's Patented Development Tool & Production Process



- Feedstock 
- Vaporised 
- Cooled & Modified 
- Nano Product 



IML is one of the few companies that has both a powerful development tool *and* scalable production process



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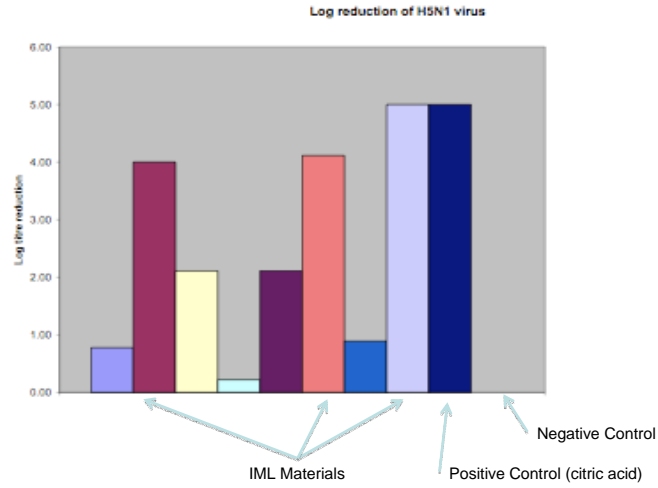
## IML nanomaterials

 <p><b>Metals</b></p> <p>Aluminium, <u>Copper</u> Silver, Nickel Cobalt, Titanium Stainless Steel Tungsten, Silicon Tantalum Molybdenum</p>	 <p><b>Oxides</b></p> <p>Zinc Oxide, Copper Oxide Cerium Oxide, Tin Oxide Cuprous Oxide, Titanium Dioxide Nickel Oxide, Zirconium Oxide</p>	 <p><b>Carbides and Nitrides</b></p> <p>Tungsten Carbide Aluminium Nitride Aluminium Oxy Nitride Silicon Nitride Boron Nitride</p>	 <p><b>Mixed Materials</b></p> <p>Blends Alloys Doped Structured Stoichiometry</p>
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## Antiviral Actives vs Influenza Virus – H5N1 (bird flu)

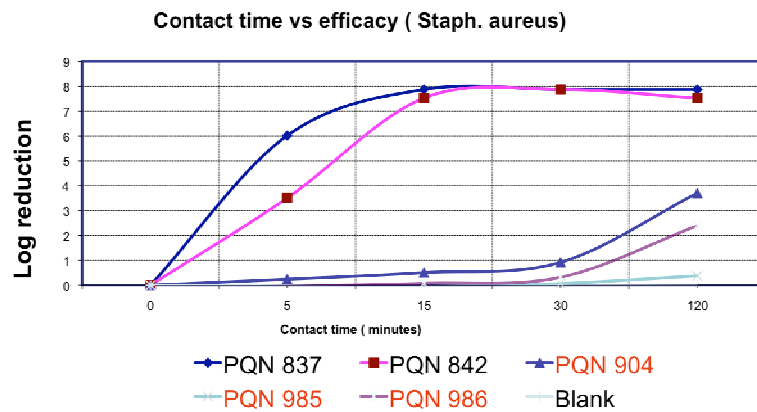


### Actives Screening vs Controls

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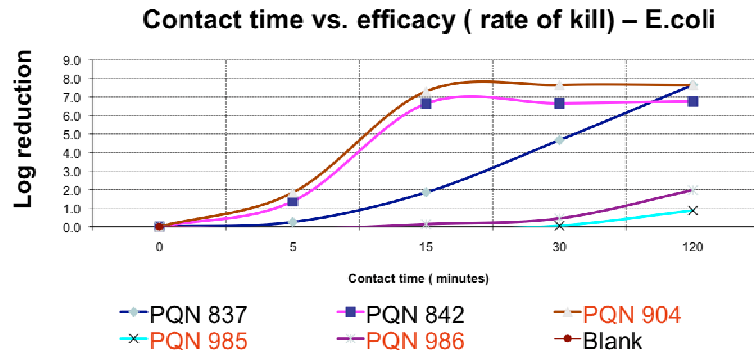
## Antibacterial efficacy – Staph. aureus



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## Antibacterial efficacy – E.coli

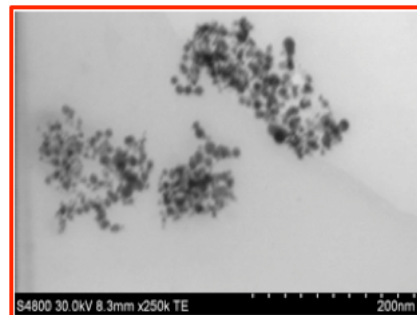
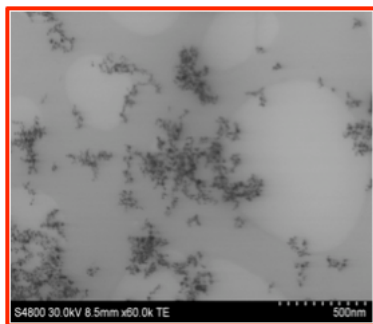


**PQN 842; effective for both organism ( 6-6.5 log reduction in 15 minutes)**

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## Dispersion (in house technique, water base)



**Extremely small particle distribution – easy to disperse**

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## Application Flexibility



Uncoated



Nano coated

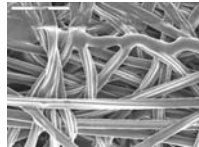


Coated paper

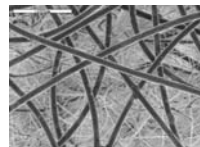


Nano-latex glove

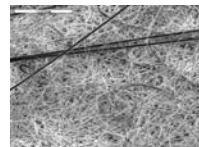
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Melt blown  
nonwoven



Spun bond  
polyester



HEPA glass  
fiber

Filter media coated with active material



## Intrinsiq Materials' Solution

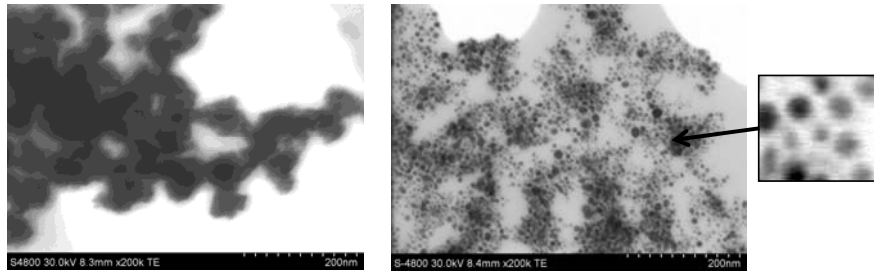
- **Broad Spectrum Biocide**
  - antibacterial / antiviral / antifungal
- **Performance**
  - Inorganic material and not organic material
  - Durable
  - Effective
- **Processing Flexibility**
  - Technology to incorporate nanoparticles into fibers / coatings etc
- **Safety**
  - Components are well known and generally considered as safe

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## Modification of Nanoparticles

- Reactive gases in the reactor can be used to minimize or remove unwanted contaminants
- Particles can be coated to prevent agglomeration and surface oxidation
- Coating can be designed to degrade on sintering



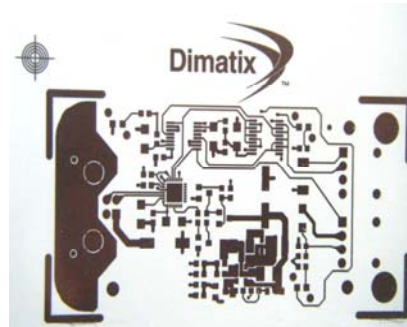
STEM images showing the effect of coating on particle morphology  
(10nm initial particle size)

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## Ink Formulation

- Viscosity / surface tension can be varied to meet application demands
- Compatible with Standard industrial low cost Inkjet print heads (XAAR & Dimatix)
- Circuits ready for population
- Conductivity suitable for carrying digital signals
- Printing on low temperature substrates



Less than 0.02 g used (100 mm x 100 m tile)

### Substrate Compatibility (Tests to date):

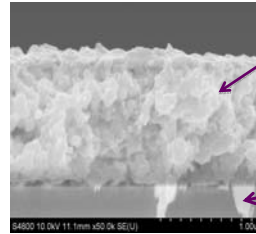
- Alumina
- Polyimide
- Glass
- Paper

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## The way forward ...

### Laser Sintering



Sintered  
Copper  
layer

Glass  
slide

Optical micrographs of laser sintered tracks at 100 and 250 micron line spacing on paper

### Market Development

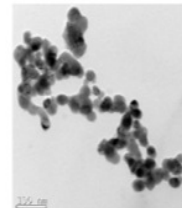
- Specialist 3D antenna application
- Multilayer structures including printing of dielectric
- RFID on paper

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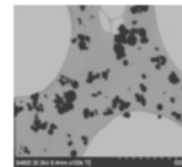


## Intrinsiq Materials' Solution

- **Production capability:** Patented, scalable process and expertise to deliver commercial volume production
- **Formulated inks:** Intrinsiq scientists have substantial experience and previous success in producing printable inks for the RFID industry
- Intrinsiq Materials has now **successfully developed a product** that is undergoing commercialisation
- **Routes to market** are being developed
- Now in discussions to take the product forward **in collaboration with industry**



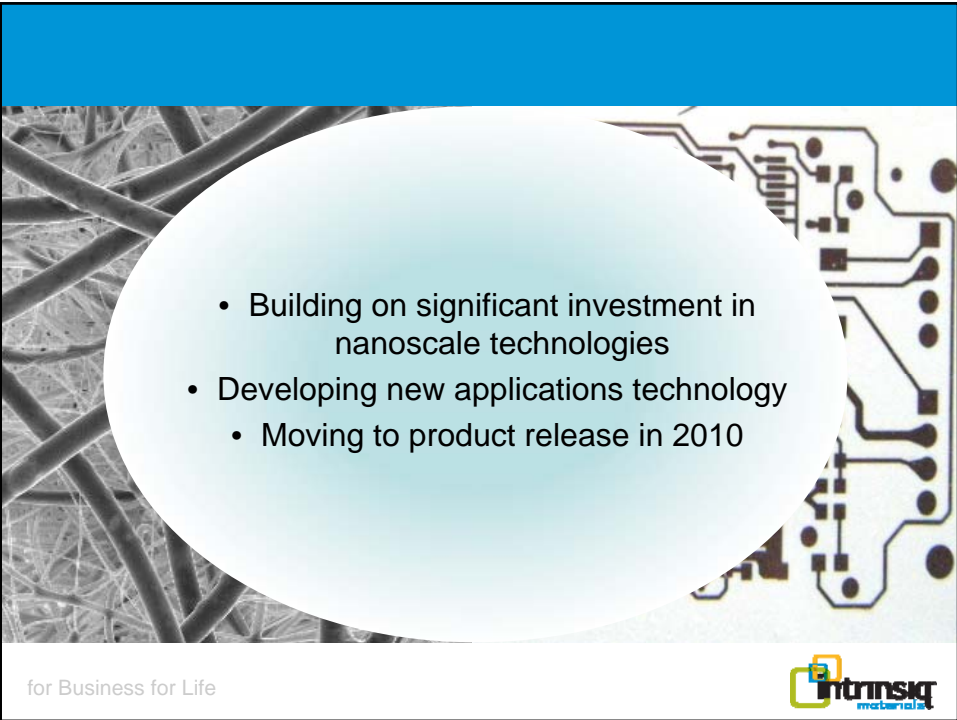
Existing SoA technology



IML Coated Copper  
Technology @ 15nm

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- 
- Building on significant investment in nanoscale technologies
  - Developing new applications technology
    - Moving to product release in 2010

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**Thank you**

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