

Nanoforce Technology: Partner for the Development of Advanced and High Performance Materials

World-leading advanced materials processing company with a focus on the development of processing routes that can be commercialised by industry

WHAT IS NANOFORCE?

Nanoforce Technology is a spin-out company from the Department of Materials, Queen Mary, University of London. It was set up as a part of the Micro and Nanotechnology (MNT) Network funded by the Department of Trade and Industry (now the Technology Strategy Board) and the London Development Agency. Its remit is to develop micro and nano technologies and to disseminate the results to industry and academia for the development of new products and processes. Nanoforce specialises in technology projects either supported directly by industry or a combination of industrial funding with state support. It has experience of working for high-profile single clients and supporting consortium-based European Framework and Technology Strategy Board projects.

WHAT NANOFORCE OFFERS TO ITS CLIENTS

Nanoforce Technology excels in high-quality research and development in materials science and technology. Its close relationship with academia allows the company to have access to a vast array of expertise in the field. The company focuses on micro and nano technologies, which permits the use of a bottom-up approach to engineering problems through the control of the physical and chemical properties of materials from the atomic

scale. Supported by its high-quality researchers as well as state-of-the-art processing, analytical and physical testing equipment, Nanoforce is able to provide materials solutions for industry and academia. Our approach and equipment enable us to bridge the gap between laboratory and industrial production.

Nanoforce's core competences

Nanoforce provides solutions to clients' needs in technologies related to polymer processing, ceramics processing, coating and printing, electrospinning (including electrospun nanofibre webs), process modelling and materials characterisation.



POLYMER AND COMPOSITES

Nanoforce’s activities in the polymer and polymer composite area revolve around the concept “atoms to application”. The company has experience in diverse fields, e.g. soaps and surfactants, biopolymers and composites, conductive polymers, ballistics protection, electronics etc. We possess a suite of processing equipment with the ability to work with grams through to tens of kilograms.

The company has invested in a range of equipment which includes twin screw extrusion, injection moulding, film blowing, co-extrusion, weaving loom, filament winding, roll to roll coating and electrospinning plus many others.

NANOFORCE HAS BEEN INVOLVED IN A LARGE NUMBER OF MATERIAL DEVELOPMENT ACTIVITIES:

1) *Polymer nanocomposites* is a relatively new and high-impact field in composites, allowing unique properties to be achieved often at very low filler loading. These include electrical and thermal conductivity and gas barrier properties using nanofillers such as carbon nanotubes and nanoclays. 2) *Highly oriented fibres/ tapes*. Polyethylene is used in commodity application such as milk bottles and grocery bags, however when suitably stretched (oriented) the same polymer can be used as a ballistic fibre to stop bullets. Nanoforce has a wealth of experience in orienting many kinds of synthetic and biopolymers. 3) *Functional packaging* to pack goods from food to electronics offers a significant technical challenge. Shielding, gas penetration, gas scavenging and recyclability are a few requirements of packaging. Nanoforce has a pilot size 3 layer film blowing line, allowing the trialling of films with a functional gradient, e.g. one layer could be a water bar-

rier while another could be an oxygen scavenger. 4) *Electrospinning* for the generation of a non-woven fibre mat from polymer solutions. The fibres have very small dimensions, typically into the nanometre range. This allows the exploitation of the unique surface properties of polymers. These fibre mats can be used for filtration of very fine particulates and can include other additives such as silver for antimicrobial action.

Advanced Ceramics

Nanoforce is pioneering the exploitation of Spark Plasma Sintering (SPS) technology in the UK. SPS can sinter ceramic, metal or composite powders to high density. This includes difficult systems to densify, including ultra-high temperature and hardness carbides and borides, and refractory metal alloys. The furnace works by the rapid heating of electrically conductive dies by pulsed DC electric currents in a vacuum or inert environment. It can achieve heating rates of up to 600K /min up to 2,200°C. The rapid heating rate combined with high pressure (up to ~1GPa) opens up a new processing window and the possibility of producing new materials with microstructures and properties that cannot be achieved using conventional sintering techniques. For example, nanopowders can be processed to produce high-density nanoceramics with minimal grain growth. It can also be used to produce novel materials such as ceramic-carbon nanotube nanocomposites, as well as metastable ceramics and ceramic composites, materials that combine different phases that would not normally coexist. SPS is a high-throughput technique, which makes it ideal for quickly exploring new materials and an energy-efficient route for the mass production of materials.

Potential applications of our materials include: ballistic protection for vehicle and body armour, sputtering targets, high-temperature piezoelectric sensors and actuators, heating elements, bioceramics with improved wear properties, nano-filters, and functionally gradient materials. Nanoforce is also looking into the preparation of a wide range of sputtering targets for thin film applications, especially those based on borides, carbides and nitrides, and in the production of higher density and phase purity targets.



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