Building a new future for UK Manufacturing

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One important lesson learned from the economic crisis was that a country's economy could not solely survive on the financial services sector. In fact, the countries that were least affected by the financial downturn were the ones that relied upon the manufacturing sector to pull them out of the crisis. This was put into action following the financial crisis in the UK, where first the Labour then the current coalition government attempted to revive the manufacturing sector, focusing on what is called 'high-value manufacturing' (HVM), where advanced technical knowledge is utilised to develop products and manufacturing processes that can bring sustainable growth and high economic value.

HVM addresses a number of manufacturing challenges including:

- the development of high throughput technologies
- decreasing the lead time from design to market
- the adoption of resource-efficient manufacturing due to the limited availability of resources (e.g. energy, raw materials, etc.) and growing demand
- the need to minimise the carbon footprint, through the re-use, recycle, and re-manufacture (repair) of the existing products
- improving product performance through the use of high performance materials

These points illustrate clearly the potential of HVM as an economic driver. It helps to ensure that the UK has a vibrant manufacturing sector, but one where our competitive advantage is in the techniques and skills we use rather than the volume.

Birmingham is making a number of key contributions to this field. The research conducted in the advanced materials and processing group (AMPLab) considers the ethos of HVM through assessing a number of manufacturing techniques, commonly referred to as net-shape manufacturing (NSM). NSM or near-NSM refers to the manufacturing of a product in its final shape or near to its final shape, to minimise the energy and material waste in the finishing operations, which are known to contribute up to two-thirds of the manufacturing cost of a product.

Our work in Birmingham focuses on the use of powders as a feedstock for manufacturing, through a number of technologies including net-shape powder hot isostatic pressing (commonly referred to as 'powder metallurgy'), where powders get consolidated into solid products through the application of temperature and pressure. In addition, we combine the use of powders with lasers to melt the powders to create complex shapes, which is referred to as additive layer manufacture (ALM) or sometimes 3D metal printing. ALM specifically has become one of the fastest growing technologies in the 21st century, especially as it liberates the designers from the constraints imposed by the manufacturing methods, enabling them to design the product based on its functional requirements rather than on how to make it. We also investigate a new class of joining methods, referred to as 'friction welding techniques' that utilise frictional heating to join difficult-to-weld materials.

These technologies are exciting, innovative and provide opportunities for business to create products more efficiently and to a higher specification. We try always to make it clear that we are materials scientists, supporting the manufacturing sector through developing new materials, or assessing the suitability of new materials for those advanced manufacturing processes. As such, our main experimental tools, including electron microscopy, X-ray and neutron diffraction, and mechanical characterisation, help us tailor and probe the material structure. Nowadays aerospace manufacturers are looking for light structural materials that are capable of bearing more loads, and/or operating at high temperatures, with limited environmental degradation.

Over the years, AMPLab has collaborated with a number of major UK aerospace manufacturers, especially Rolls-Royce plc, which has a University Technology Centre hosted by the School of Metallurgy and Materials to train the future generations of materials and manufacturing engineers. Current project at AMPLab approach in value £ 4.5 millions (2013), from the EU (FP7 programme), TSB, EPSRC and a number of industrial contracts. The group works closely with the Catapult's Manufacturing Technology Centre (MTC), providing the academic leadership for the netshape and additive manufacturing theme.

These relationships are symbiotic as they help businesses to innovate but they provide our lab with ideas to help shape our research and teaching. Although there are many good examples of these relationships between academics and business we would like to see more being done to recognise the important role they play in driving innovation in the economy. More support would enable British manufacturing to maintain its reputation for innovation and quality in a highly competitive global marketplace.

Notes on AMPLab:

The 36-researcher strong AMPLab is based in the Interdisciplinary Research Centre (IRC) for Materials Processing, in the School of Metallurgy and Materials. The research programme carried out in AMPLab aims at understanding the influence of advanced materials processing techniques (additive manufacturing, powder processing, and solid-state joining) on the microstructure-property development in advanced materials. Simultaneously, the research activities aim at developing new materials, and assessing their process-ability using a number of advanced manufacturing methods.