Scoping study of laser patterning of thin-films for high volume manufacture of electrical structures

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This scoping study will assess laser patterning and thin-film deposition for integration into a single manufacturing process, potentially able to deliver high volume, low cost electrical structures. This is an area that has been widely studied in terms of the physics of the laser-material interaction but has received less attention in its optimisation as a route for device fabrication. Achieving a reel-to-reel process would have a significant impact in terms of electronics manufacturing. There are good prospects that this approach could complement other disruptive technologies such as carbon based electronics, identified as areas of focus in the recent EIGT report, and offer a competitive advantage in terms of compliance with environmental (WEEE & RoHS) legislation. In particular, the authors believe that there will be interplay between the optimum film characteristics for a particular device and the most advantageous laser processing parameters. Key to the programme is identifying this process window. This leads to a collaborative approach whereby the Cleaner Electronics Research Group at Brunel will produce test samples and characterise the devices and the Laser Group at Hull will perform the ablation trials.

There are an increasing number of applications for an effective low-cost integrated production system for patterned conductive thin films, including RFID, large area displays and flexible electrical interconnect. This study however will focus on the manufacture of low-cost thermoelectric devices. A novel production technique has been developed that allows the manufacture of complete bi-material thermocouple arrays in one non-stop, reel-to-reel process. This process negates the need for costly and time consuming pattern registration and involves no sacrificial process agents, both of which have been obstacles previously preventing low-cost, high-volume manufacture of these multi-material devices.

There are a large number of potential uses for low-cost thermocouples including sensor arrays and the harvesting of waste heat and solar energy. The field of renewable energies is a burgeoning one, with an increasing awareness of Climate Change issues driving consumers and government legislation towards increasing investment, both financial and intellectual in the development of new energy harvesting, and energy conserving technologies. It is imagined that a successful low-cost thermoelectric power generation system could find application in sectors as diverse as the electricity generation industry in which large amounts of 'low-grade' heat is vented using cooling towers, to the automotive industry, which has already identified the benefits of capturing otherwise wasted engine heat. Much interest has already been expressed in the application of this technology to the capture of solar energy, particularly in a developing world context. One of the project collaborators is actively involved in this aspect of the research and a number of possible applications have been investigated including the accretion of minerals from seawater for the production of artificial coral reefs and the manufacture of building materials for coastal communities.