ADVANCEMENTS IN DIFFUSION BONDED MICROCHANNEL HEAT EXCHANGERS (MCHXS)

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The United Kingdom has a growing need for heat transfer devices, driven by various factors across many sectors. Energy efficiency is crucial in advancements of heat transfer devices as the UK looks to improve energy utilisation in industrial processes, power generation and heating systems. The UK's focus to shift to renewable energy, achieving increased decarbonisation and improved sustainability requires industry to innovate and collaborate to achieve these goals.

Microchannel heat exchangers (MCHXs) have been the focus of intense study in the academic sector for around 20 years, with an escalation in recent times due to the severe heat management issues associated with current and emerging applications in technology areas such as energy production and space. The space sector, in particular, is implementing thermodynamic cycles in what can be considered very high temperature and high pressure environments.

Additive manufacturing (AM) processes, whilst offering potential for MCHX manufacture, also present some significant challenges that can affect performance and reliability, such as surface roughness, part accuracy and material properties. Diffusion Bonding is an advanced manufacturing process that allows enhanced heat exchanger design, offering several advantages in terms of improving the durability, efficiency and performance of the heat exchanger. The process is also a solid-state process, which can achieve little to no deformation of the material, allowing for intricate features such as integrated headers, and sub 150µm wide channel geometries, not achievable by conventional welding or brazing processes.

This presentation will provide a short insight into the capabilities and requirements related to MCHX manufacture and then introduce a number of examples of project work. This will include the development of the diffusion bonding parameters for aluminium-alloys, titanium-alloys and, in a project supported and funded by the European Space Agency (ESA), the development and validation of a compact, light-weight and high performance gaseous heat exchanger model manufactured from stainless steel.