# A review of shape memory alloy research, applications and opportunities

# Jaronie Mohd Jani, Martin Leary, Aleksandar Subic, Mark A. Gibson

## Abstract

Shape memory alloys (SMAs) belong to a class of shape memory materials (SMMs), which have the ability to ‘memorise’ or retain their previous form when subjected to certain stimulus such as thermomechanical or magnetic variations. SMAs have drawn significant attention and interest in recent years in a broad range of commercial applications, due to their unique and superior properties; this commercial development has been supported by fundamental and applied research studies. This work describes the attributes of SMAs that make them ideally suited to actuators in various applications, and addresses their associated limitations to clarify the design challenges faced by SMA developers. This work provides a timely review of recent SMA research and commercial applications, with over 100 state-of-the-art patents; which are categorised against relevant commercial domains and rated according to design objectives of relevance to these domains (particularly automotive, aerospace, robotic and biomedical). Although this work presents an extensive review of SMAs, other categories of SMMs are also discussed; including a historical overview, summary of recent advances and new application opportunities.

## Keywords Shape memory alloy; Shape memory materials; Automotive; Aerospace;Biomedical; Robotics