TITLE: MODELLING AND DEVELOPMENT OF COLD SPRAY FOR ADDITIVE MANUFACTURING (CSAM) WITH NON-CONVENTIONAL NOZZLES

ABSTRACT: Cold spray can be defined as direct material deposition process by high kinetic energy powdered particles, traveling along carrier gas up to supersonic speeds 300 – 1400 m/s and impacting on a substrate. After its discovery in 1980s, Cold spray technique have been widely recognized as superior surface coating method than traditional coating methods because of its ability to deposit powder particlesbelow its melting temperature. Further, the cold spray has also been visioned as alternative to traditional additive manufacturing based on powder melting. The utilization of cold spray for additive manufacturing (CSAM) or scope of manufacturing in space, material part repair and fabricating multi-material components in smaller time have led to renewed interest in developing and optimizing the cold-spray technique. Nozzle designs are heart of cold spray method, traditionally used as circular nozzle. The supersonic nozzles accelerate the flow, based its convergent-divergent section design as well as pressure ratio of upstream and environment pressure. A particular design of circular nozzle can give maximum acceleration at design operating pressure ratio. Off-design condition may lead to overexpansion and under-expansion of flow causing complicated shockwave structures in the jet flow- field. This jet-flow field can be manipulated by various flow control methods to increase or decrease mixing from surrounding environments. This manipulation of shock-structure and flow fields coming out from supersonic jet can significantly increase or decrease the impact of particles on substrate. In the proposed study, non-conventional nozzles e.g. elliptic, rectangular, multi-lobed ESTS (Elliptic Sharp Tipped Shallow) along with required passive flow control will be investigated for various operating conditions and combination of material powder and substrate. The impact of various metal powder using the above non-conventional nozzles will be accessed initially by numerical modelling and simulations.

Further, it is proposed to develop a pilot test-set-up within available research funding. The testing andvalidation of characteristics of deposited samples will be planned in collaboration with SEAM center atWIT.

Contact: Dr. Ashish Vashishtha: e. Ashish.Vashishtha@itcarlow.ie