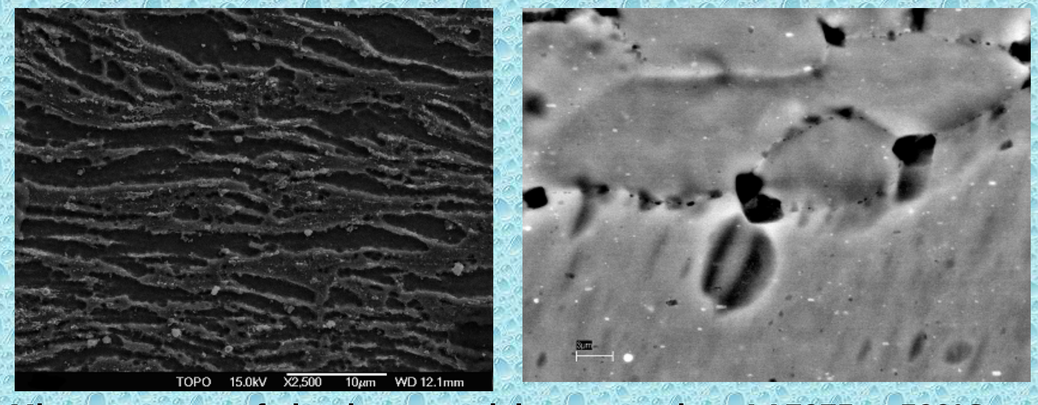
UNIVERSITÀ DEL SALENTO

ANALYSES OF COLD SPRAY COATINGS PROPERTIES MULTI-OBJECTIVE APPROACH BY modeFRONTIER®

Angelo Perrone, Pasquale Cavaliere, Alessio Silvello - University of Salento, Department of Innovation Engineering

Experimental and numerical procedure

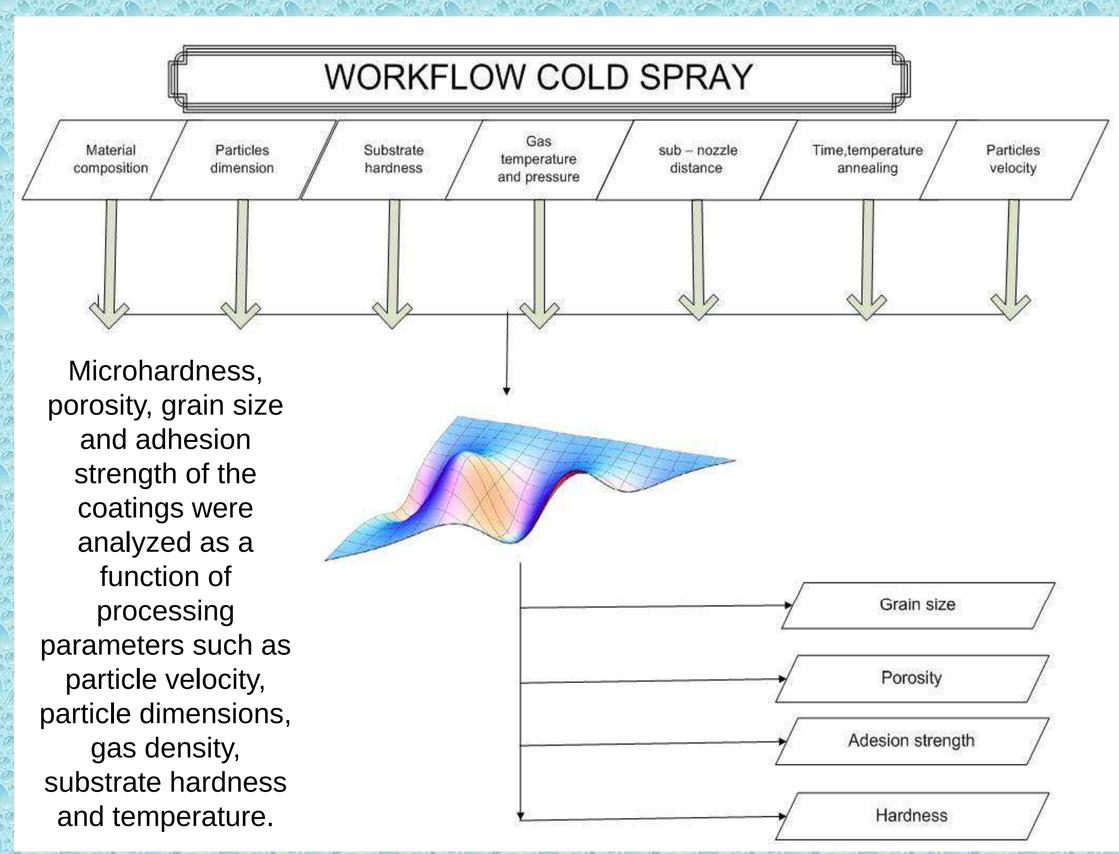
The microstructural and mechanical properties of metal-metal cold spray deposits are studied. Different spray particles coatings (Al-, Ti-, Ni-based particles) deposited on different substrates (Al-, Ti-, Fe-, Ni-, Mg-based bulk materials) were produced and their mechanical and microstructural properties were characterized. Different weight of the processing parameters affecting the mechanical and microstructural properties of the deposits was calculated by modeFRONTIER.



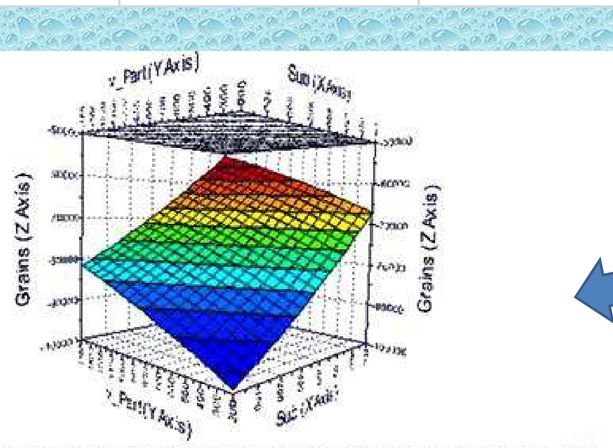
Microstructure of aluminum particles sprayed on AA7075 at 500°C and 1.5 MPa

Particles velocity (m/s)	Deposit grain zize (nm)	Deposit microhardness (Hv)	Adesion strength (Mpa)
616	32	165	50
751	28	200	146
845	26	345	148
859	33	317	223
959	34	380	233
1009	21	390	275
820	29	310	54
940	28	273	235
1074	28	335	280
1092	28	264	90
1079	28	284	275
1073	26	331	50

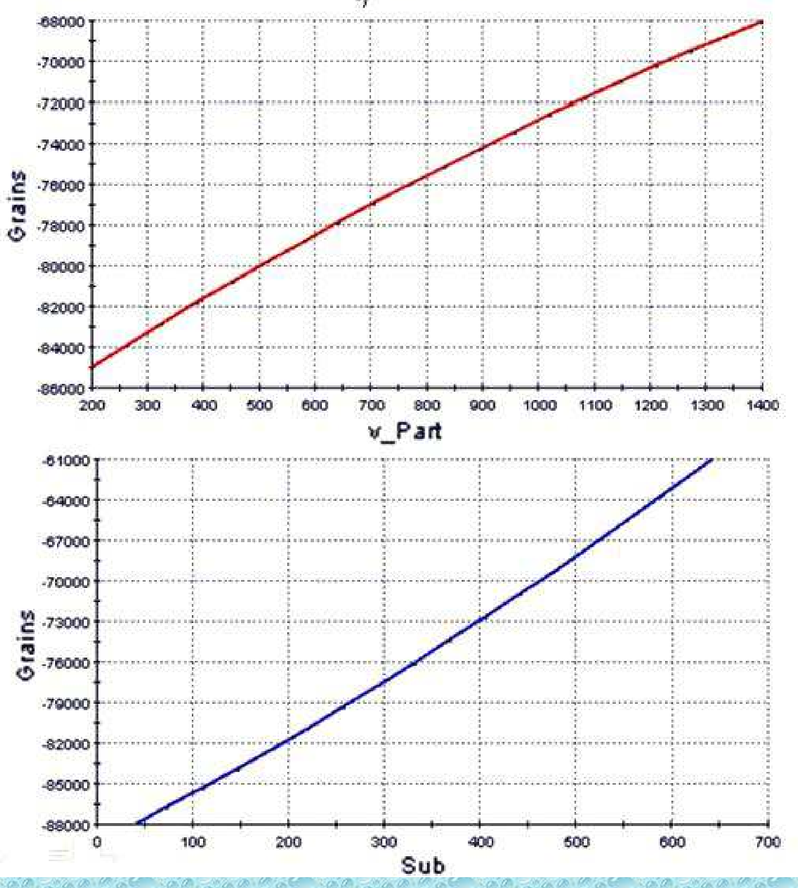
The results were employed to build a database consisting of 376 experimental conditions. The results were analyzed through modeFRONTIER in order to develop a provisional model capable of simulating the deposit properties as a function of different processing parameters.



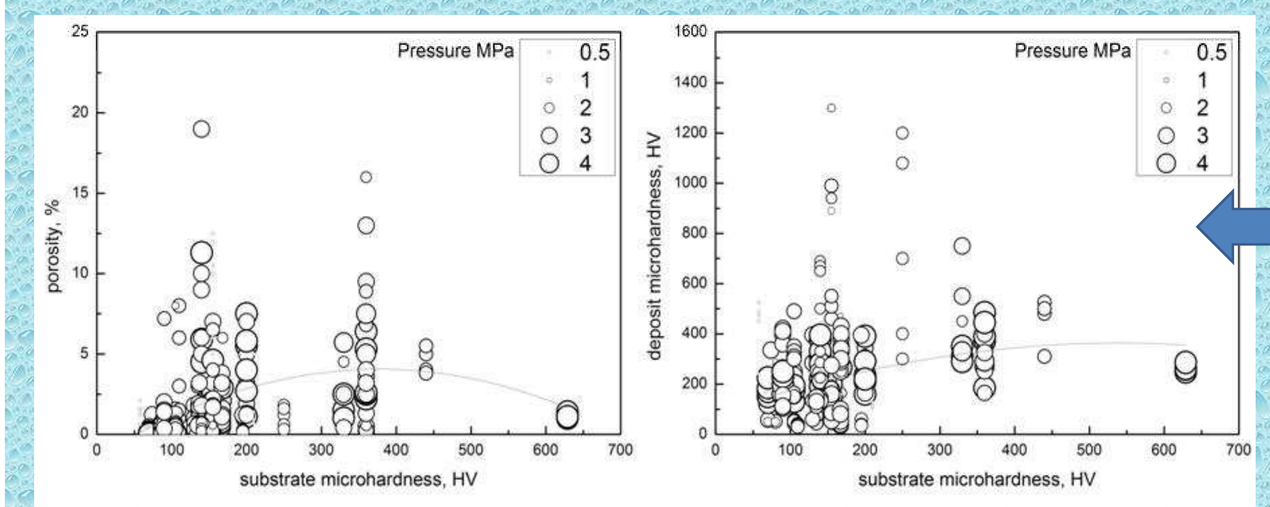
Microhardness, porosity, grain size and adhesion strength of the coatings were analyzed as a function of processing parameters such as particle velocity, particle dimensions, gas density, substrate hardness and temperature.



An interesting result is represented by the grain size behavior. Figure shows how the deposit grain size decreases with the increasing of the particle velocity and the substrate hardness



Grain size vs. particles velocity and substrate hardness (Grains is the deposit grain size; Sub is the substrate hardness; v_Part is the particles velocity).



Deposit microhardness and porosity, as a function of substrate microhardness and gas pressure dependence, is clearly shown in figure

A very different behavior was observed by changing sprayed particles and substrates. In figure the adhesion strength and deposit porosity as a function of gas pressure and temperature in the case of aluminum particles on AA2024 and AA7075 substrates are shown. The results were coupled because no big differences were observed in the deposition of pure Al particles on such substrates.