Parameters Controlling the Generation and Properties of Plasma Sprayed Zirconia Coatings

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Abstract : D.C. plasma jets temperature and velocity distributions as well as the arc root fluctuations at the anode were studied for Ar-H_2 (25 vol%) plasma forming gases. The parameters were the arc current up to 700 A, the total gas flow rate up to 100 slm, and the nozzle diameter which was varied from 6 to 10 mm. The trajectories of partially stabilized zirconia particles into the jet were studied by a 2D laser imaging technique and two fast (100 ns) two color pyrometers. The results has reveal the difficulty to inject small particles into the plasma flow since most were found to by-pass the jet rather than penetrate it. The results also show the broad trajectory distribution within the jet and the influence of the arc root fluctuations on the mean particle trajectory distribution within the jet. Beside the measurements of the particle surface temperature and velocity distributions in flight, the particle flattening and the cooling of the resulting splats were studied statistically for single particles all over the spray cone. Such studies have emphasized the drastic influence of the substrates or previously deposited layers temperature on the contact between them and the splats. At 200-300°C this contact is excellent (cooling rates of the order of 100 K/µs for 1 µm thick splats) and it results in a columnar growth within the splats and the layered splats of a bead (up to 500 layered splats). This growth can be observed through passes provided the bead surface temperature has not cooled too much (a few tens of K) before the next bead covers it. A/C values up to 60 MPa were achieved with PSZ coatings. The effect of impact velocity of the particles, of substrate preheating temperature, of relative movments torch to substrate, of substrate oxidation on A/C values and splat formation were also studied.