

Research highlights

Coating technology: Interaction of free falling copper droplets with heated substrates

Controlling the physical properties of the surfaces of materials, such as metals, is critical for industrial applications ranging from non-stick frying pans to the fuselage of aircraft. However, in spite of the wide spread use of the so-called thermal spraying method for coating large areas of materials, there is still insufficient knowledge about the physical mechanisms—in particular the so-called 'splat process' whereby thermally sprayed particles change from a distorted shape at the splash stage, to a disk shape—that govern the properties of sprayed particles with substrates. Such an in-depth understanding is important for improving the control and reliability of thermal spray-based coatings.

Here, Masahiro Fukumoto and co-workers at the Department of Mechanical Engineering, Toyohashi University of Technology, describe their recent findings on the splat formation process to determine why and how disk-shaped splats are formed.

Fukumoto and his group studied the effect of substrate temperature and ambient pressure on the behavior of millimeter sized, molten copper (Cu) droplets free falling onto AISI304 steel substrates.

Important findings included the observation that the porosity at the splat bottom surface dramatically decreased with increasing substrate temperature and decreasing pressure, which implies that substrate wetting by molten droplets during splat flattening may be enhanced by using higher substrate temperatures and lower spray pressures. Notably, good wetting at the splat/substrate interface resulted in disk-shaped splats, and in the opposite case, the formation of splash-splats under poor wetting conditions.

These experiments on the flattening behavior of individual splats will be useful for controlling the properties of coatings on materials by the thermal spraying process.

Reference

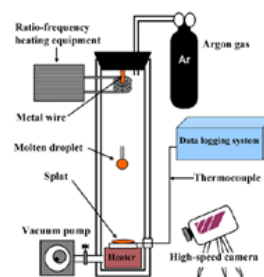
- M. Fukumoto, K. Yang, K. Tanaka, T. Usami, T. Yasui, and M. Yamada
- Effect of Substrate Temperature and Ambient Pressure on Heat Transfer at Interface Between Molten Droplet and Substrate Surface
- *Journal of Thermal Spray Technology* **20**, 48–57, (2011)
- Abstract and restricted links: <http://www.springerlink.com/content/v81677q1872w52pr/>
- DOI: 10.1007/s11666-010-9537-5
- Department of Mechanical Engineering, Toyohashi University of Technology, Toyohashi, Aichi 441-8580, Japan

Related information

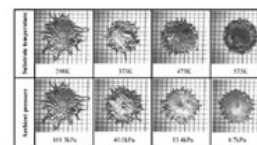
- Advanced Joining Process Laboratory, Toyohashi Tech: <http://ajp.pse.tut.ac.jp/>



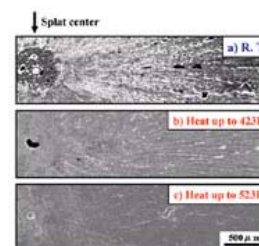
Masahiro Fukumoto



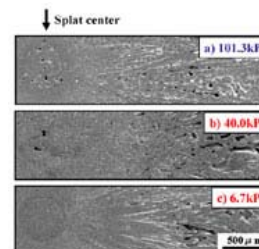
Experimental set up for monitoring free fall of Cu droplets onto steel substrates.



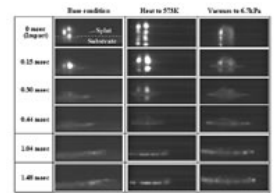
Variation of the splat shapes with substrate temperature and ambient pressure.



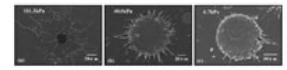
Variation of the bottom of splats with temperature.



Variation of the splat bottom surface with ambient pressure



Observation of the free fall of Cu droplets by high speed camera.



Variation of the top morphologies of Cu droplets on AISI304 substrates with ambient pressure.