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Numerical Study of Heat Transfer Effect of Wire EDM on P91, SS304, Al 1050 using COMSOL Multiphysics

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WIRE ELECTRIC DISCHARGE MACHINING

- Wire Electric discharge machining (WEDM) is a non conventional machining process.

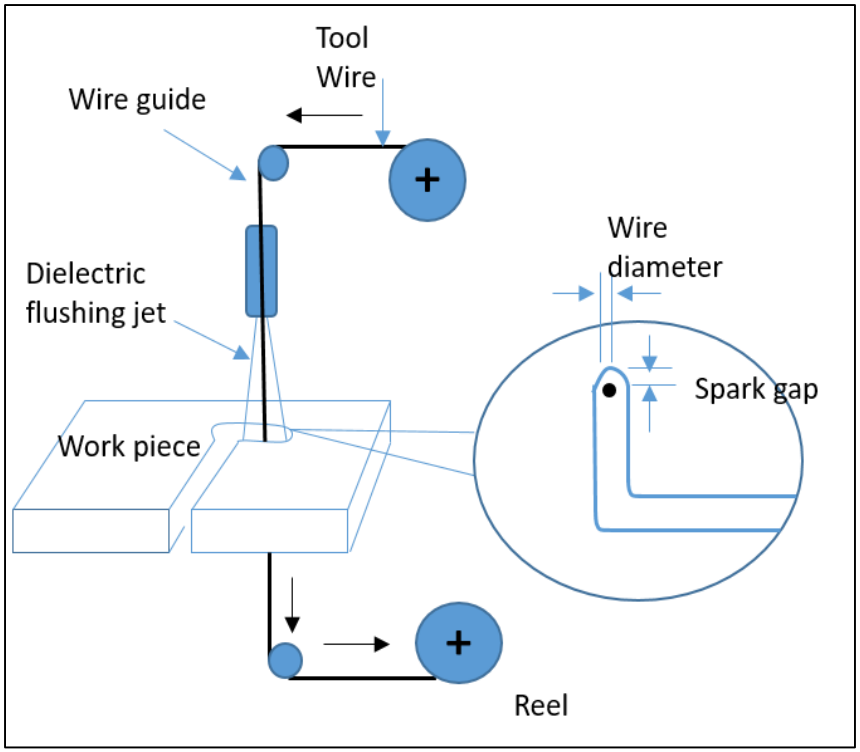
- It is an electro –thermal spark erosion process which erodes material using high temperature spark

- Spark is generated between the two electrodes separated by a dielectric medium like demineralised water

WIRE ELECTRIC DISCHARGE MACHINING

- High voltage imparted to the electrodes causes breakdown of dielectric leading to generation of discharge.

- High temperature spark melts the work piece material and molten material is eroded by the flushing jet of dielectric.
- The eroded material forms crater and affects the surface roughness of the machined surface



NUMERICAL MODELING

- COMSOL 5.4 is used to model the WEDM process

- Size of crater formed after the erosion is estimated for SS304, AL1050, P91 steel

- Heat transfer module with phase change is used to model the heat transfer process occurring in WEDM process

NUMERICAL MODELING

- Heat conduction in the work piece is modelled using Fourier heat conduction model

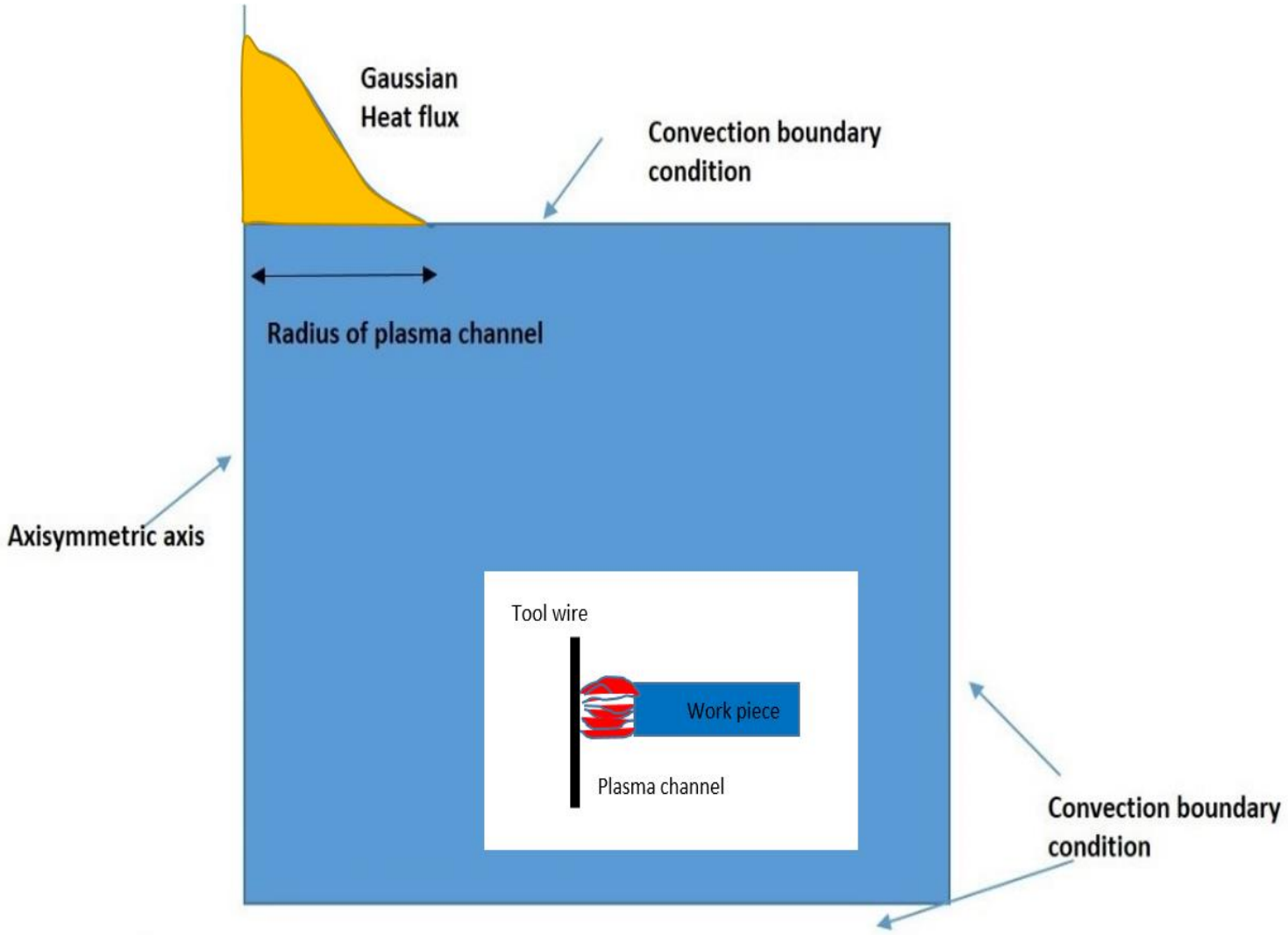
- A space dependent Gaussian heat flux of the order of 10^{11} W/m^2 is applied on the work piece

- To model the pulsed heat flux event module of COMSOL Multiphysics is used

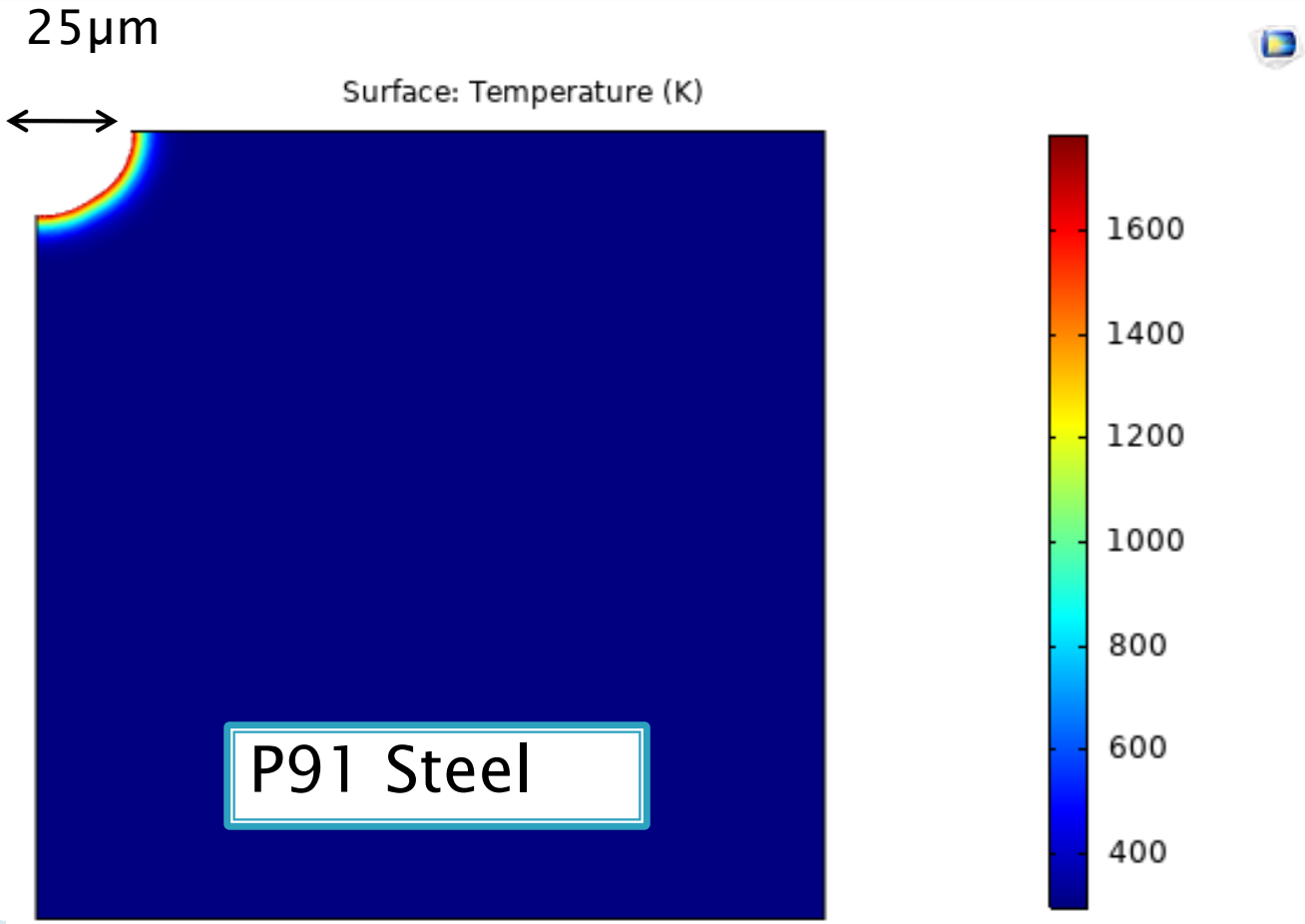
- Temperature dependent property of the material is taken into consideration

- The numerical results were verified with the actual crater sizes obtained by Scanning Electron Microscope images of the machined surface

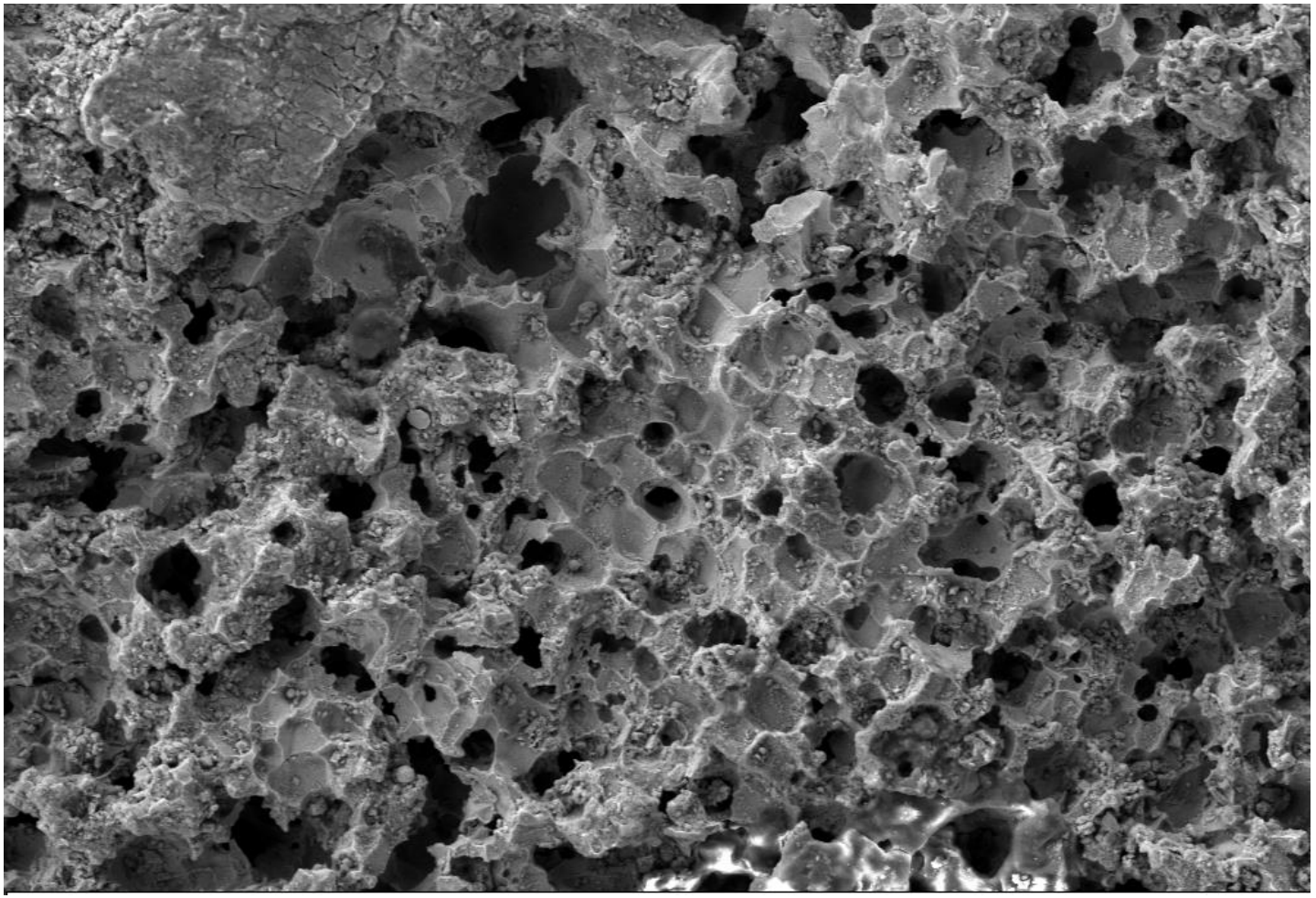
FOURIER HEAT CONDUCTION MODEL



Temperature distribution on P91 work piece after spark is off

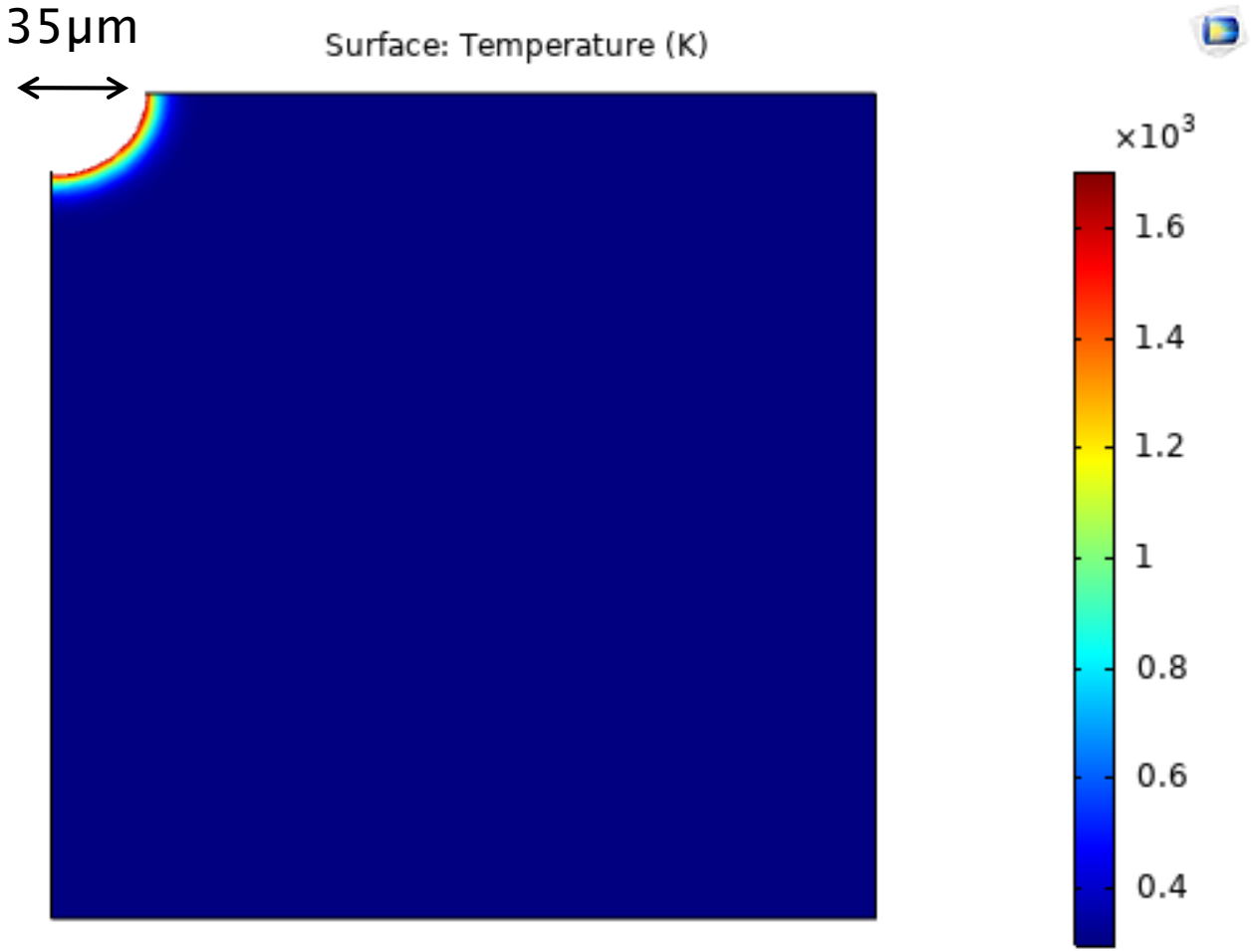


SEM image of machined surface of P91showing craters



10µm

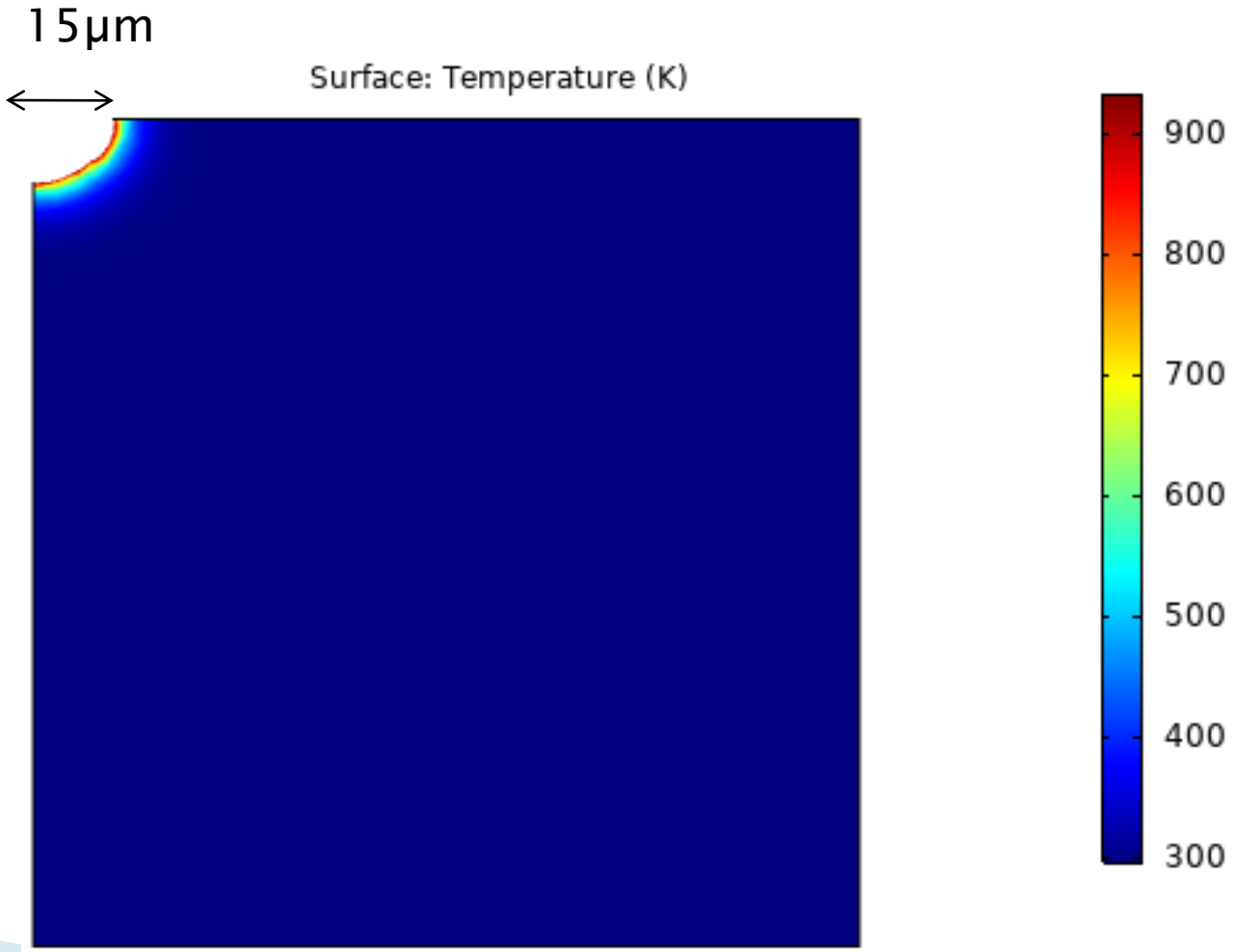
Temperature distribution on SS 304 work piece after spark is off



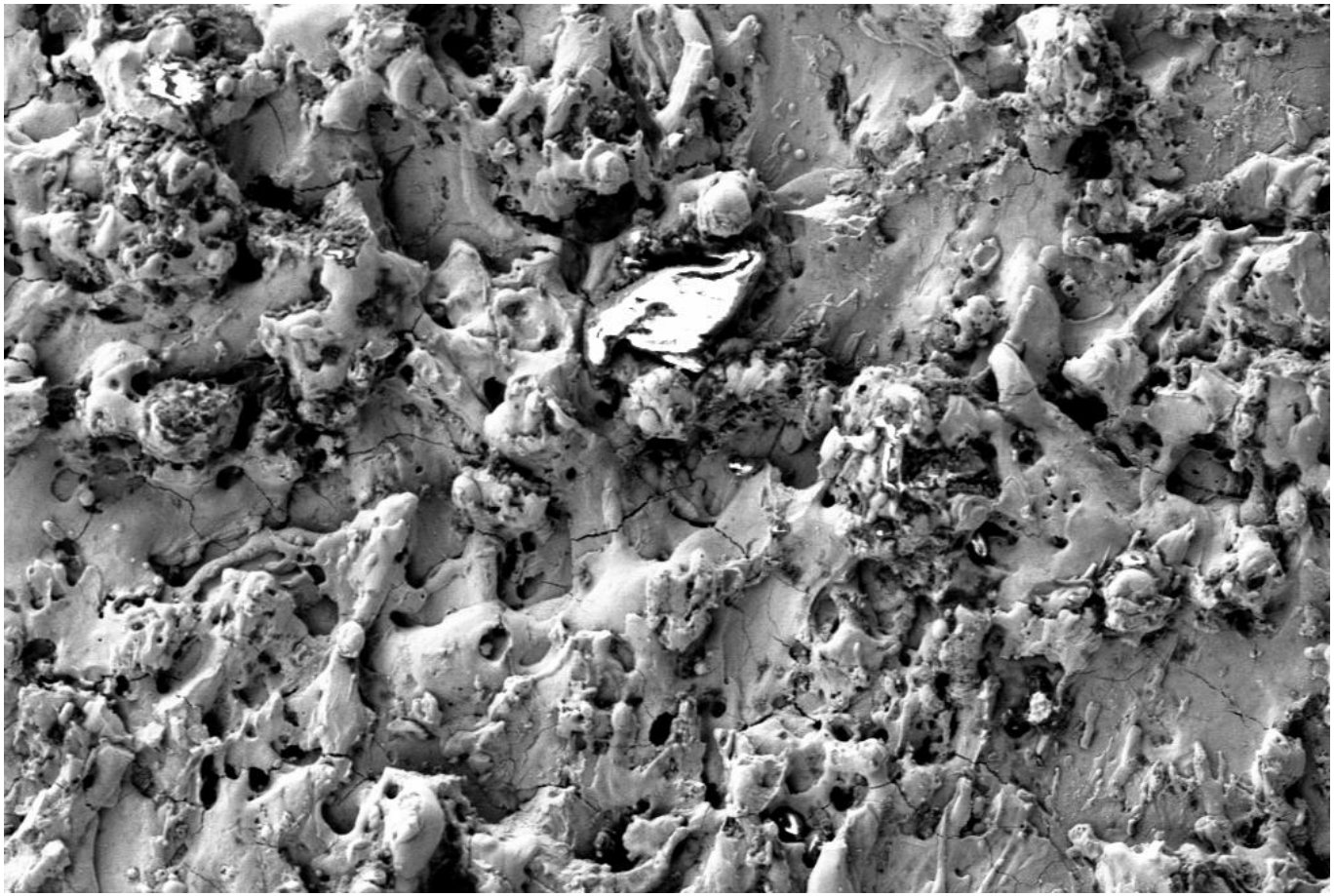
SEM image of machined surface of SS showing craters

20μm

Temperature distribution on AL1050 work piece after spark is off



SEM image of machined surface of Al1050 showing craters



20μm

Thank you