Rapid Material Development And Processing Of Complex Near-Net-Shaped Parts By PIM

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Motivation:

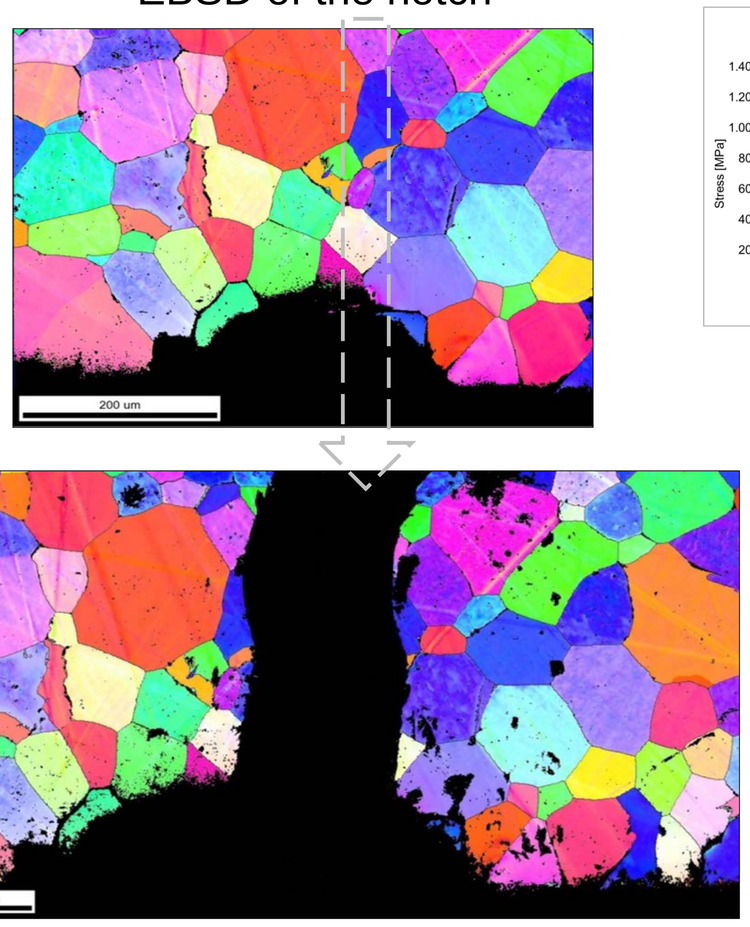
The manufacturing of tungsten parts by mechanical machining, such as milling and turning, is extremely cost and time intensive. Tungsten Powder Injection Molding (W-PIM) is a promising manufacturing method in view of large-scale production of parts with high near-net-shape precision, hence, offering the advantage of a cost-saving process compared to conventional machining.

RAPID MATERIAL DEVELOPMENT

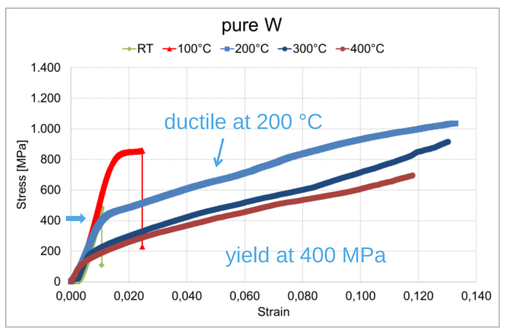
4-Point-Bending Tests

Sample geometry: (12 x 1 x 1) mm
Constant strain rate: 0.0330 mm/min

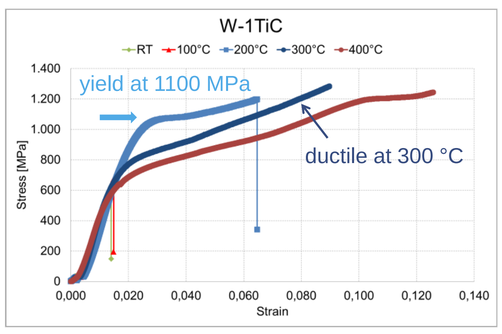
EBSD of the notch

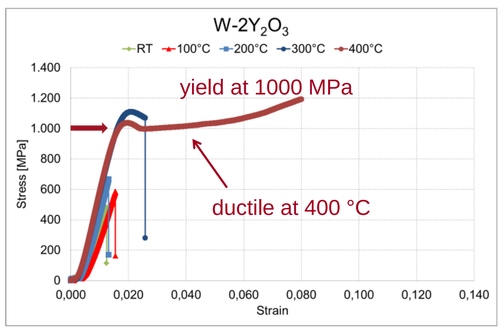


Pure W @ RT: transgranular crack.

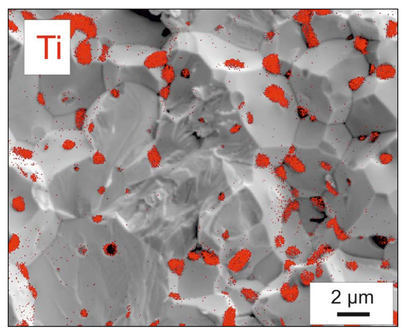


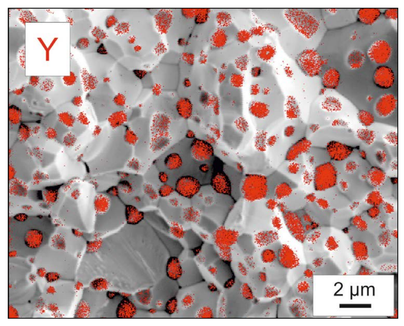
Grain size:
Pure W: 50 – 100 µm
W-1TiC: 4 – 6 µm
W-2Y_2O_3: 4 – 8 µm

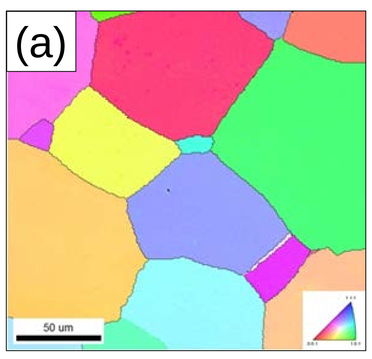


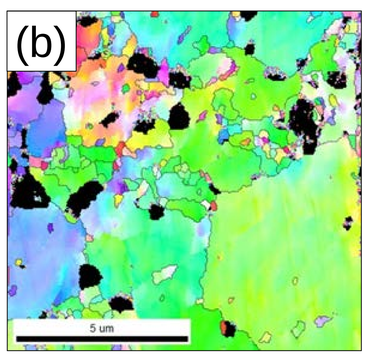


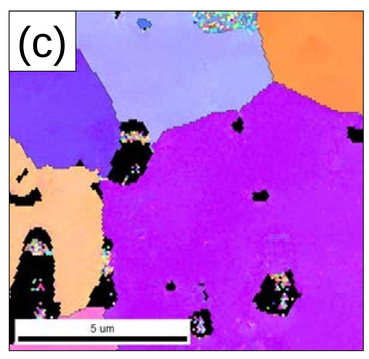
AES: Microstructure & element allocation.







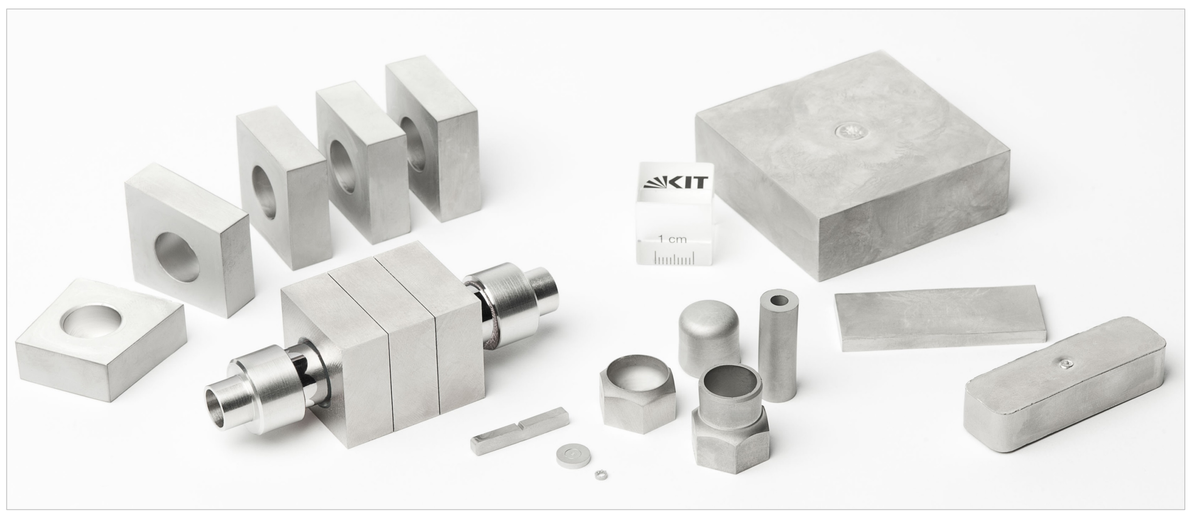




EBSD maps: (a) pure W, (b) W-1TiC, (c) W-2Y_2O_3. The black spots are (b) TiC respectively (c) Y_2O_3 particles.

PROCESSING OF NEAR-NET-SHAPED PARTS

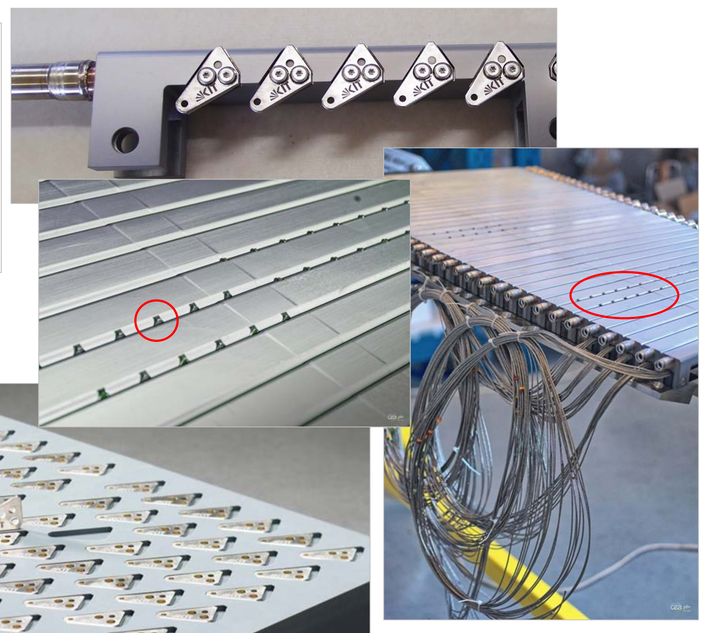
Up- and down scaling in size dimensions and shape complexity



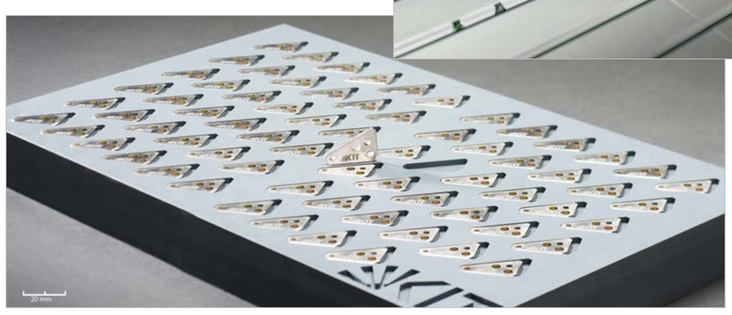
The range of dimension of the produced W-PIM parts are from a micro gearwheel 3 millimetres in diameter and a weight of 0.050 grams, up to a 1.4 kilo plate with the dimensions 60 x 60 x 20 mm.

W-PIM Langmuir probes for the WEST project

Device to determine the electron temperature, electron density, and electric potential of a plasma.



Water-cooled CuCrZr PFU.



Installation of a series of 60 Langmuir probes by CEA in Summer 2016.

Conclusions:

PIM as special process allows the mass production of components, fabrication of composite and prototype materials, and is an ideal tool for scientific investigations.

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