Microstructural evolution at high temperature under two tensile strain rates of Ti6Al4V-Additively Layer Manufactured & 3D3C project preparation progress

High temperature tensile tests were first performed on TA6V4 fabricated by additive manufacturing of powder layers by laser fusion at Mines Albi-France.
The microstructural evolutions were then studied by EBSD, XY tomography and optical microscopy.at TLC-IMR.
The progress of the preparation of the Japan/France/Canada collaboration on ALM powder issues is reported.

I had the privilege to stay for 2 months (4 June-4 August 2022) in the laboratory of Professor Akihiko Chiba at IMR. The purpose of this stay was to consolidate exchanges on ALM with his laboratory, which is a major player in ALM. I was extremely impressed, although I expected it, by the breadth of ALM research topics covered by Professor Akihiko Chiba's team through the work of his colleagues and several of his superbly active students. I was able to visit very efficient facilities run by experienced and very competent staff. I was also very impressed when I visited with Professor Akihiko Chiba the JAMPT Corporation (Japan Additive Manufacturing Processing and Technology) centre and its president Ryota Kusaka. The resources that JAMPT has devoted to ALM in such a short period of time are a testament to the immense amount of work that is being done meticulously and efficiently.

I also had the opportunity and privilege to meet Professor Hiuoyuki Fukuyama and discuss his unique experiments and methods of measuring the physical properties of liquid phase martial metals by electromagnetic or electrostatic levitation. In situ neutron diffraction tensile tests (J-PARC) were initiated by Prof. Kenta Yamanaka on Ti6Al4V-ALM. During my stay, with the close collaboration of Dr. Sun Jiayu, we were able to work on the evolution of the microstructure (Fig. 1 & 2) and damage of this alloy during high temperature tensile tests (730°C and 840°C and strain rates of 10-2 and 10-4 (mm/mm)/s) carried out at Mines Albi in order to compare it to the behaviour of the ultrafine-grained Ti6Al4V alloy, which exhibits superplasticity at these temperatures.

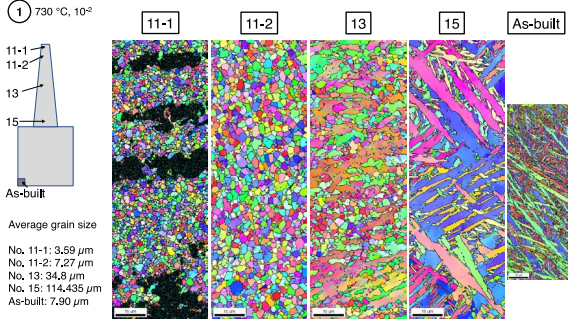

Fig.1 Grain evolution along the gauge length under as-fabricated conditions (EBSD: 730°C@10-2 (mm/mm)/s))

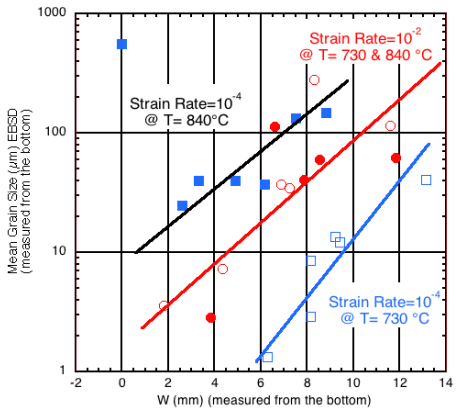

Fig.2 Evolution of the average grain size along the gauge length from the bottom to the fracture surface of the tested plate samples for both strain rates and temperatures.

Powders are indeed the essential raw materials for the new disruptive technology of ALM (3D manufacturing). These meetings allowed us to propose a tripartite scientific and technical research between Japan, France and Canada (3Countries) on joint international collaborations (named 3D3C) for the characterisation of powders obtained by different technologies.

Progress in the preparation of 3D3C

MR's unique and highly efficient characterisation facilities and powder production facilities in these countries are essential for the success of such an international collaboration. French industries such as Safran, Constellium and Addup have already expressed their interest. The "France Additive" association, which brings together all the players in additive manufacturing in France, is interested in this type of project. The Institut de Recherche Technologique Matériaux Métallurgie et Procédés (IRT-M2P) with the LEM3 laboratory has developed a machine for characterising the spread of powders that is much more representative than the current standardised tests. This laboratory will be contacted for this project. In collaboration with Professors Akihiko Chiba and Kenta Yamanaka and the IRT-M2P, we will carefully pursue the development of this project.

Keywords: Ti6Al4V, ALM, high temperature tensile test, EBSD

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