MONASH University

Monash Centre for Electron Microscopy

Seminar

The use of a combination of materials characterization and computational modelling for the development of new high entropy alloys and metastable beta-titanium alloys

Thursday 27 June, 2019	**Hamish L Fraser**
11.00am	**Center for the Accelerated Maturation of Materials, Ohio State University**
Engineering Lecture Theatre E5, 21 College Walk, Monash University, Clayton Campus	

Abstract:

Regarding high entropy alloys, in recent studies, a number have exhibited microstructures with combinations of B2 and bcc phases. An example of one such alloy is $AlMo_{0.5}$ $NbTa_{0.5}TiZr$. This study has been aimed at a determination of the transformation pathways that lead to the final microstructure. Alloy samples have been heat-treated at 1300 ºC for 24 hours and then cooled at a rate of 10 ºC/min in an inert gas atmosphere. Samples were quenched at various times during the furnace cool and have been characterized. It appears that the transformation pathway appears to involve a disorder (bcc) – order (B2) transition followed by conditional spinodal decomposition to two ordered B2 phases, and then congruent disordering for one of the components of the spinodal. This has been simulated using computational thermodynamics and phase field modeling. Regarding the study of refinement of the precipitation of the α phase in Ti alloys, a comparison has been made between precipitation of the α phase in two metastable Ti alloys, T-5553 and the model alloy Ti-20V, in which the ω phase exhibits the ellipsoidal and cuboidal morphologies, respectively. Using a number of different heat-treatment schedules, the degree of refinement of the α precipitation has been determined using advanced characterization techniques including scanning electron microscopy, transmission electron microscopy, aberration-corrected scanning transmission electron microscopy and atom probe tomography, coupled with computation simulation via phase field modeling. Super-refined α precipitation was generated in Ti-5553 through a tri-step isothermal aging and in Ti-20V via dual-step isothermal aging. The mechanism of ω phase assisted α precipitation in the two metastable β titanium alloys is discussed, and it is shown that the degree of refinement of ω the phase is determined more significantly by the details of the heat-treatment schedules rather than ω shape. This work has resulted in a new method for development of metastable β Ti alloys which will be described.

The Presenter:

Dr. Fraser graduated from the University of Birmingham (UK) with the degrees of B.Sc. (1970) and Ph.D. (1972). He was appointed to the faculty of the University of Illinois in 1973 (Assistant, Associate and Full Professor), before moving in 1989 to the Ohio State University (OSU) as Ohio Regents Eminent Scholar and Professor. He was appointed as a Senior Research Scientist at the United Technologies Research Center from 1979-1980. He has also been a Senior von Humboldt Researcher at the University of Göttingen, a Senior Visitor at the University of Cambridge, a visiting professor at the University of Liverpool, and he spent a sabbatical leave at the Max-Planck Institut für Werkstoffwissenschaften in Stuttgart. He has been an Honorary Professor of Materials and Technology at the University of Birmingham since 1988. In 2014, he was recognized as an Honorary Professor at the Nelson Mandela Metropolitan University in Port Elizabeth, South Africa. He is also an Adjunct Professor at Monash University in Australia and at the University of North Texas. At present, he serves as Director of the Center for the Accelerated Maturation of Materials (CAMM) at OSU. He has been a member of the National Materials Advisory Board and the US Air Force Scientific Advisory Board. He has consulted for a number of national laboratories and several industrial companies. He is a Fellow of TMS, ASM, IOM3 (UK), and MSA. He has published over 425 papers in scholarly journals, and given over 360 invited presentations

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