Applications of advanced electron microscopy in material research: collaborative opportunities

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Over the past four decades, electron microscopy involved into an important tool for studying the structures of materials with the view to improve material performance through the knowledge of property-structure relationships. A Chinese - US cooperative project has been established utilizing advanced electron microscopy techniques in support of a number of material research programs. These programs involve several teams from the USA and China. Among them, the Microscopy & Imaging Center at Texas A&M University provides state-of-the-art microscopy facilities, such as a LEO Libra (923) transmission electron microscope (TEM) with field emission gun (FEG) and an analytical resolution down to 1 nm using STEM, EELS and EDX, a JEOL 2010 with an image resolution of 0.19 nm, and a LEO 1530 FEG scanning electron microscope with advanced in-situ dynamical study capabilities. The BIAM in China is very active on a wide range of materials research topics and hosts the National Key Laboratory for Advanced Composites. The following areas have, so far, been covered this collaborative initiative:

(1) Interfacial structures of composite materials

The interfacial structure significantly influences the composite performance, and thus the microscopic analysis of the interfaces is a key to understand and improve materials behavior [1,2].

(2) Microstructure of high-temperature superalloy for aerospace applications

The Ni-base superalloys are mainly used for rotor blades in gas turbines owing to their superior mechanical properties at elevated temperatures. TEM observations proved crucial to understand the tensile deformation behavior at elevated temperatures [3,4].

(3) Complex quasicrystals and related phases

The Mg-Zn-RE (RE: rare earth) quasicrystals were originally observed by Z.P. Luo in 1993[5] when working with S.Q. Zhang on the structure-property relationships of high-strength aeronautical magnesium alloys. Current research work focuses on the structure of this system and involves a complex collaboration[6] between TAMU and ANL (electron microscopy), the Ames Lab (sample preparation), and CAS (X-ray crystallography).

In conclusion, we demonstrate a highly synergistic and successful collaboration between strong Chinese and US partners in support of emerging technologies. This partnership is based on complementary expertise as well as mutual interest and understanding. It is expected to grow as further collaborative opportunities arise in the future.

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