PHYSICAL ELECTRONICS

APPLICATION EXAMPLES FOR THE EBSD OPTION

On the PHI *700Xi* Scanning Auger Nanoprobe

INTRODUCTION

Auger Electron Spectroscopy (AES) is well known for providing compositional information from nanoscale sample features and ultra thin films. For some polycrystalline materials, the distribution of crystalline orientations and grain boundary misorientations is of critical importance for the performance characteristics of the material. To meet the analytical need to provide compositional and crystalline information from small areas, PHI has made available an Electron Backscatter Diffraction (EBSD) detector as an optional accessory for the PHI *700Xi* Scanning Auger Nanoprobe.

EBSD OPTION

When an electron beam strikes a crystalline material the emitted electrons, which are diffracted by the structure of the material, form a diffraction (Kikuchi) pattern that can be detected on a fluorescent screen. Materials with different crystalline orientation and structure produce different diffraction patterns. By linking the EBSD detector to the scanning electronics of the *700Xi*, a two dimensional EBSD image can be created by scanning the electron beam and evaluating the diffraction pattern at each pixel of the image. These images contain crystal structure and orientation information that can be correlated with compositional AES images. This application note contains EBSD images obtained from polycrystalline silicon, stainless steel, a copper alloy weld, and a polycrystalline nickel sample. Figure 1 shows the physical configuration of the EBSD detector in the PHI *700Xi*.

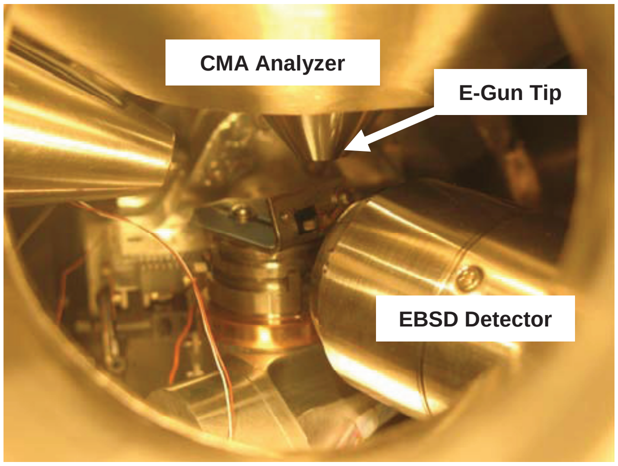

Fig. 1: EBSD Configuration

APPLICATION EXAMPLES

Figure 2 shows an inverse pole image of a polycrystalline silicon surface. This image shows the grain size varies from 0.4 to 5 μm and that most of the grains have the [101] crystal orientation which is displayed in green.

Figure 3 shows EBSD images from a stainless steel sample which indicate the presence of body and face centered cubic structures (bcc and fcc). Figure 3a shows the bcc and fcc grains are distributed streaks with the width of several microns. The area ratio of the bcc and fcc regions is 48:52 and the bcc regions are composed of larger grains than the fcc regions.

Figure 4 shows a secondary electron image and an inverse pole image EBSD image from a section of a copper alloy weld. The EBSD image shows many of the grains have a [001] orientation and that there is also a significant number of grains with a [111] crystal orientation.

Figure 5 shows an inverse pole image of a large area from polycrystalline nickel sample which indicates the grains are large and most of them have a [111] crystal orientation.

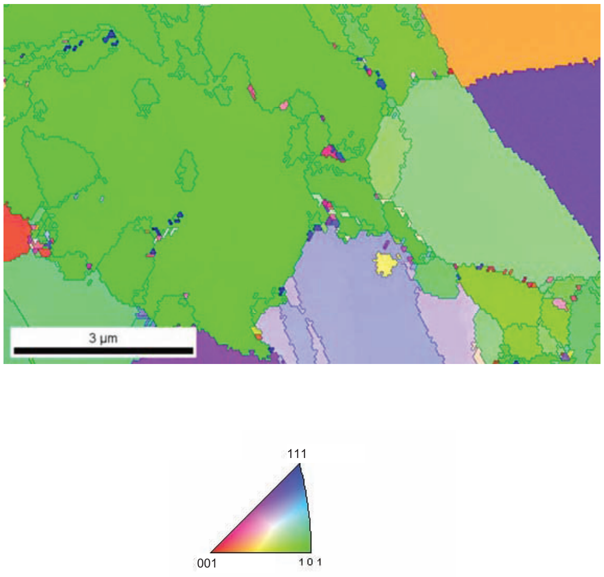

Fig. 2: Inverse pole figure of polycrystalline silicon.

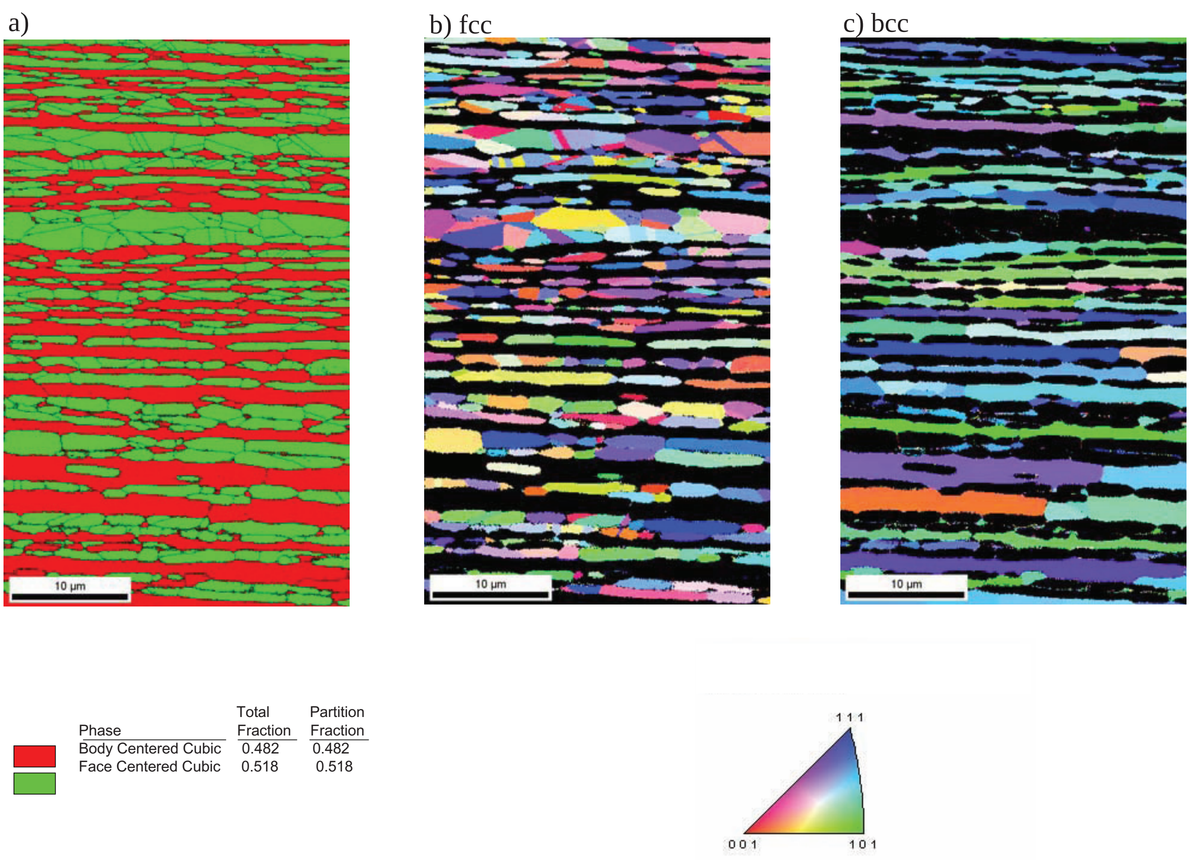

Fig. 3: Result of EBSD of stainless steel sample which shows the coexistence of bcc and fcc crystal grains. a) Distribution of fcc and bcc areas. b) Inverse pole figure of fcc area c) Inverse pole figure of bcc area.

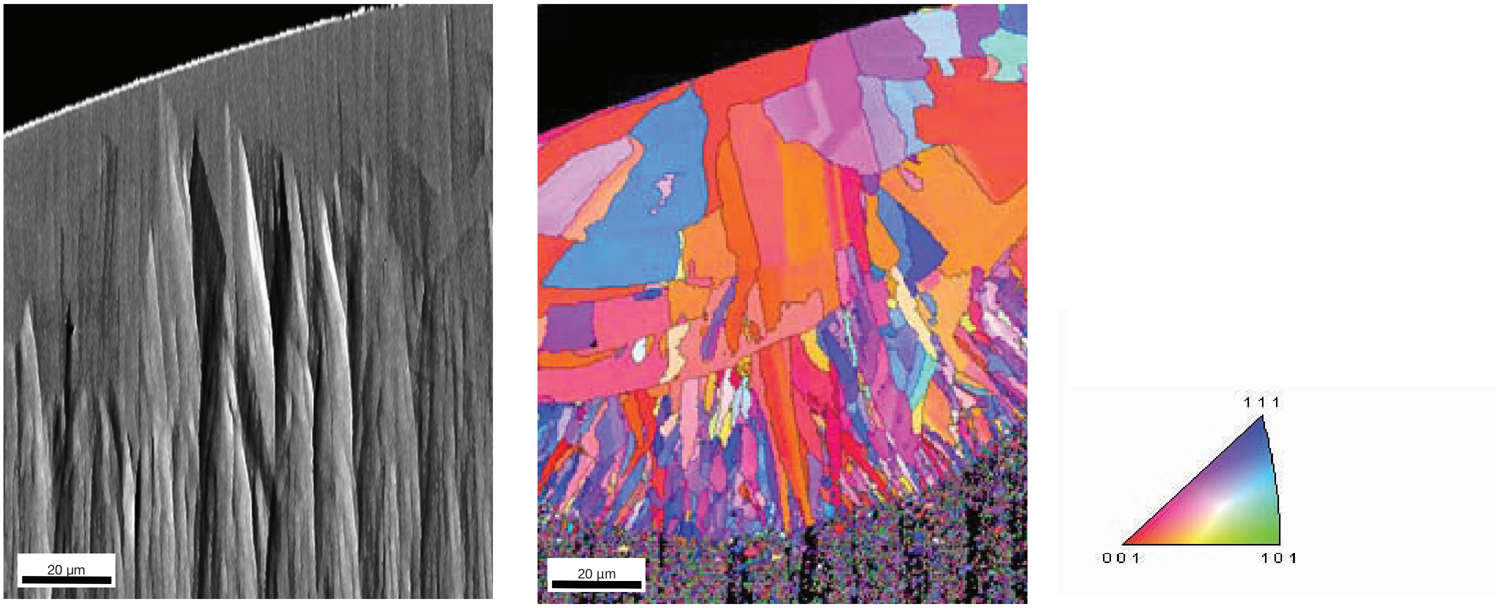

Fig. 4: Welded copper alloy cross section. a) SEM Image. b) Inverse pole figure.

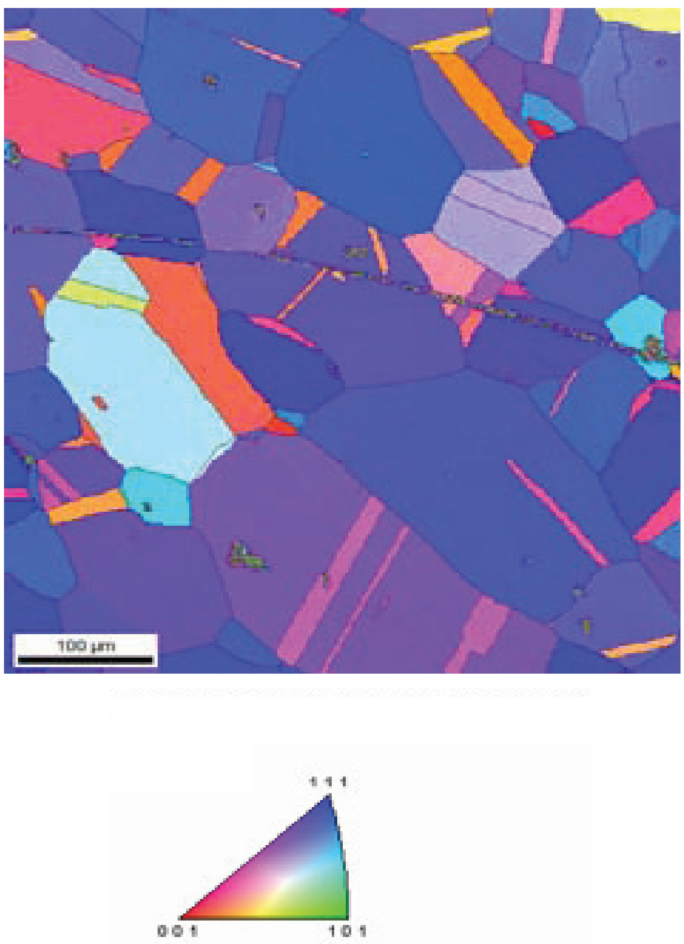

Fig. 5: Inverse pole figure of polycrystalline nickel.

Physical Electronics
18725 Lake Drive East,
Chanhassen, MN 55317
952-828-6200
www.phi.com

ULVAC-PHI, Inc.
370 Enzo, Chigasaki,
Kanagawa, 253-8522,
Japan
81-467-85-4220
www.ulvac-phi.com

PHYSICAL ELECTRONICS