ANALYSIS OF SHEAR STRESS DISTRIBUTION IN AL (CU) INTERCONNECTS INDUCED BY ELECTROMIGRATION BASED ON SCHMIDT'S LAW AND STUDIED BY SYNCHROTRON POLYCHROMATIC X-RAY MICRODIFFRACTION

We report here an in-depth synchrotron radiation based polychromatic X-ray microdiffraction study of plasticity in individual grains of an Al (Cu) interconnect line during the early stage of electromigration. It has been well known that distortional strain/stress tensor can be obtained with high accuracy by analyzing the deviation of the Laue peak positions from their ideal positions scattered by an unstrained crystal. However, for the case of electromigration study, the Laue peaks are greatly streaked due to the arrangement of the geometrically necessary dislocations, so that it is very difficult to determine precisely the peak positions. Therefore, the strain/stress cannot be accurately measured by the conventional method. Furthermore, since the X-ray beam has a certain spot size, rather than an ideal spot, there is strain gradient, as well orientation gradient, within the irradiated volume of the sample. As a result, we developed a new method to estimate the shear stress loaded in an individual grain based on Schmidt's law by two steps, including the analysis of the activated slip system in a given grain by simulation method and followed by Schmidt factor calculation. By this means, we obtained the shear stress distribution within the sample induced by electromigration.