Laue MicroDiffraction on French Beamline BM32 at ESRF

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ABSTRACT

X-ray scattering experiments on polycrystals at micrometer scale have shed new light on structure and mechanical behavior of unique or assembly of small systems such as semiconductors devices, metal interconnects, MEMS. Conventional scattering on single crystal is a powerful and advanced structural technique but is generally difficult to set up at this scale needing time-consuming data collection procedures. Laue diffraction corresponding to the scattering of a white (polychromatic) beam overcomes this limitation: A large number of Bragg reflections is collected on a 2D detector from a single x-ray shot. This Laue pattern is analysed in two steps: orientation recognition (indexation) and strain refinement for each crystal grain. Laue MicroDiffraction allows a fast and non destructive 2D mapping of grain to grain orientation and strain with a submicrometer spatial resolution. Only few beamlines on 3rd generation synchrotron facilities offer an intense white micron-sized beam dedicated to materials science. French CRG-IF-BM32 beamline located at ESRF has operated since 2006 a microdiffraction setup unique in Europe, running complementary Laue and monochromatic diffraction techniques. It is delivering a stable narrow x-ray probe (beamsize: <1X1 µm^2) to determine the local full strain tensor in various *in situ* loading environments (e.g. temperature, electromigration and mechanical stress). Developments aiming at increasing the instrument throughput are underway: improved automation to fit increasing characterization needs from microtechnologies and extension towards 3D resolution allowed from the larger penetration capability of x-rays.

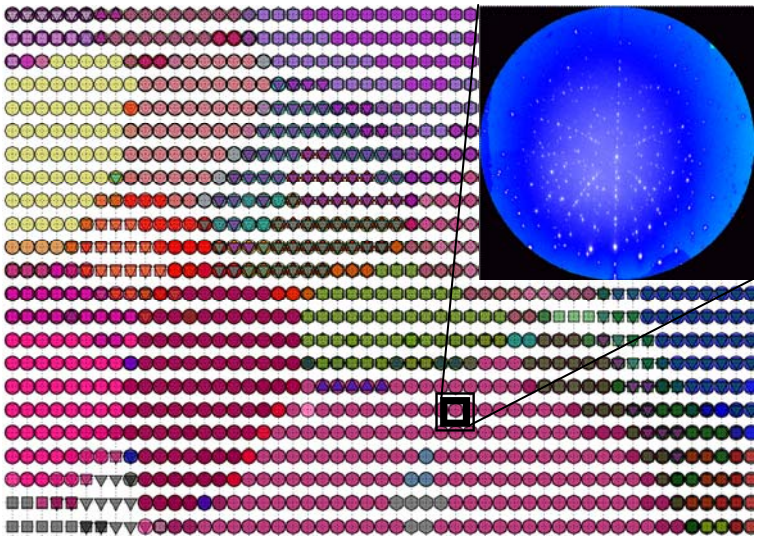

FIGURE 1. Determination of local orientation and strain of several grains at each mapping step (1 micron) from the analysis of of the Laue microdiffraction pattern (insert).