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WHITE MICROBEAM X-RAYS FOR 3-D INVESTIGATION OF MATERIALS MICROSTRUCTURE

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WHITE MICROBEAM X-RAYS FOR 3-D INVESTIGATION OF MATERIALS MICROSTRUCTURE

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Although the physical properties of nearly all technologically important materials are critically impacted by the structure and physical processes occurring on mesoscopic length scales of tenths of microns to hundreds of microns, 3D non-destructive structural tools for investigations in this regime have not been available. The availability of high brilliance synchrotron x-ray sources and new high-precision x-ray focusing optics have made possible revolutionary advances in microbeam x-ray capabilities for the investigation of materials on these mesoscopic length scales. In this presentation we discuss the development of a new, polychromatic x-ray microbeam technique that, for the first time, provides measurements of the structure, orientation, and stress/strain tensor in materials with micron or submicron resolution in all three directions. The essential aspects of the technique, based on the use of diffracted beam profiling, will be discussed and its application demonstrated by 3D measurements of the strain tensor in elastically strained Si. The fundamental importance of 3D x-ray microbeam capabilities for addressing longstanding mesoscale materials physics issues will be discussed