

MAR05-2004-005884

Abstract for an Invited Paper
for the MAR05 Meeting of
the American Physical Society

Fast in-situ, high-resolution PDF analysis studies of glasses and nanocrystalline materials

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We are increasingly interested in complex materials for their unique functional properties. Complex materials often exhibit nanoscale local structures that are important in determining their properties. These come about from defects but often are intrinsic, coming from competing interactions in the materials. It is important to characterize these “nanostructures” but this is difficult because they are not, by their nature, long-range ordered and cannot be studied using traditional crystallographic methods. The atomic pair distribution function (PDF) analysis method has, for a long time, been used to study the structure of glasses and liquids. I will describe recent developments in both data collection and analysis that make this method a powerful quantitative probe of nanostructures. In particular, intense high energy x-rays from third generation synchrotron sources now make it possible to study materials in-situ under extreme conditions while studying their local atomic structure. The experiments are quick opening the way to time-resolve studies.