Atomic Structure Transformations of C-Doped Ge2Sb2Te5 Using In-Situ X-Ray Scattering

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Phase change materials (PCMs) are characterized by their fast transformation speeds from their amorphous to crystalline states, with each state having distinct properties. These unique and distinct properties can be used for data storage and even computation, with their proposed application to enable neuromorphic computing. Ge2Sb2Te5 (GST) is a widely used PCM due to its fast-switching speeds and good data storage capabilities. However, it also has a low crystallization temperature, which makes long-term data storage (>10 years) difficult. One way to improve this is to alloy the material with carbon, which has been found to increase both the transformation temperature and the stability of the cubic phase.

To understand the effects of carbon, we are investigating how atomic structure transformations are modified by carbon doping (from 0% to 12%, molar) via in situ X-ray scattering, including X-ray diffraction (XRD) and pair distribution function (PDF) analysis. These methods provide access across local, mid-range, and average structure scales, and variations thereof through their amorphous-to-crystalline transformation. By identifying this atomic structure over the process, we can establish structure-property relationships and how these vary with composition. This new understanding is necessary to tailor GST, or other PCMs, for current and future applications, such as data storage and computing.

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