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Irreversible Damage in Amorphous Silica CINDY ROUNTREE, CEA,DSM,IRAMIS,SPCSI, DAMIEN VANDEMBROUCQ, Laboratoire PMMH, ESPCI, STEPHANE ROUX, LMT, ENS-Cachan, ELISABETH BOUCHAUD, CEA,DSM,IRAMIS,SPEC — Glass touches every aspect of our lives including the glass dishes which we cook with to the storage of nuclear waste. The extensive use of oxide glasses can be attributed to optical transparency, electrical and heat insulation, and large hardness. However, oxide glasses have a major drawback: brittleness. Even small flaws in the structure can lead to the ultimate failure of the material. Recent Atomic Force Microscope experiments and Molecular Dynamics simulations revealed a process zone ahead of the crack tip where damage nucleates, augments, and finally merges with the advancing crack front. Furthermore, when a-SiO_2 samples are nanoindented, one finds permanent damage under the indenter in the form of densified silica. To shed light on the origin of irreversible deformation in amorphous media, we have expanded our studies to examine what happens to an oxide glass when subjected to shear. MD simulations have been performed in a-SiO_2 systems which are subject to a shearing force at room temperature. The system was initially isotropic and as long the maximum shear deformation remains under 5% the system remains isotropic upon unloading. However if the system is sheared to a point greater than 5% permanent plastic deformation sets in and the system is no longer isotropic upon unloading.

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