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Reaching the Yield Point of a Glass During X-Ray Irradiation

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A solid loaded beyond the yield stress loses its elastic properties and becomes plastic. From a microscopic point of view, this limit corresponds to the condition where plastic regions become so densely packed that they give rise to system-spanning structures. This limit for glasses is abrupt, which makes experimental investigations challenging. Here, the yield point is reached by the alternative approach of increasing the density of plastic regions by generation of point defects during x-ray irradiation. For the case of a LiBO₂ glass, we show that at low doses, i.e., for a low density of defects, the defects behave as isolated stress sources that induce atomic displacements typical of an elastic solid. As the density of defects increases, the mechanical response of the glass at the local scale changes from elastic to more and more plastic, until reaching the limit where it becomes characteristic of a flowing system, which signals that the yield point is reached.

Primary author: MONACO, Giulio (University of Padova)

Presenter: MONACO, Giulio (University of Padova)

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