Radiation response of bulk metallic glasses and nanostructured metallic glasses: fundamentals and applications

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The past several decades have seen intensive research activities on nanostructured crystalline metals in which interface surfaces can serve as defect sinks to remove radiation-induced point defects, thereby obtaining self-defect-repairing capabilities. In comparison, very little is known about the role of surface interfaces in amorphous metallic glasses (MGs). The major question is ... Can interface surfaces in amorphous solids stop or slow down amorphous-to-crystalline transitions, in a way that is opposite when compared with their crystalline counterparts?

If such a proposition is correct, a new door is open to systematically enhance the stability of amorphous materials under harsh environments. In this talk, we will present our recent studies on fundamentals of radiation response of MGs, mechanisms of nanocrystallization under various conditions, and ion beam modification of MGs to form various nanostructured MGs.

Then we will report on our findings that show how MG surface interfaces can act as defect sinks to remove excess free volumes?, thereby suppressing nanocrystal formation. Our studies cover a wide range of MGs having different widths of super-cooled liquid regions and MGs having different boundary-to-volume ratios. In some examples, we will show how ion beams can be used to promote nanocrystallization for better mechanical properties. In other examples, we will show how ion-beam-induced re-amorphization of pre-crystallized MGs can be used for patterning of regions of different phases.

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