metals

Editorial

# Recent Advancements in Metallic Glasses

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Investigations of the structure and properties of metallic glasses constitute a subject of unabated interest. The Web of Science database gives 1400 to 1500 papers on metallic glasses published per year from 2015 to 2019. The present Special Issue "Recent Advancements in Metallic Glasses" presents ten interesting works considering both general scientific and application issues related to metallic glasses.

Seleznev and Vinogradov [1] report a detailed study of shear bands occurring in several bulk metallic glasses deformed by compression and indentation. The high spatial resolution achieved by scanning white-light interferometry gives the evidence for interaction between slip bands, as well as provides information on different scenarios of their propagation. The elastic field around a tip of the slip band was found similar to the elastic field of a Volterra-type macro-dislocation, revealing edge-like and screw-like shear components. The authors conclude that the slip bands can be described in terms of Volterra's macro-dislocations and their behavior under the load can be rationalized accordingly.

Tian et al. [2] studied the structural and mechanical properties of hydrogen-charged metallic glass. They found that nanoindentation reveal a clear increase in the elastic modulus and hardness as well as in the load of the first pop-in with increasing hydrogen content. At the same time, the probability of a pop-in decreases, indicating that hydrogen hinders the onset of plastic instabilities while allowing local homogeneous deformation. The hydrogen-induced stiffening and hardening is rationalized by hydrogen stabilization of shear transformation zones, while the improved ductility is attributed to a change in the spatial correlation of these zones.

Gunderov and Astanin [3] present a review on the influence of high-pressure torsion on the structure and properties of amorphous alloys. The variation of structure due to the processing parameters (shear strain, processing temperature, imposed pressure) is considered. Amorphous alloys with a nanocluster structure and nanoscale inhomogeneities significantly differ in their physical and mechanical properties from conventional metallic glasses. High-pressure torsion processing constitutes an efficient way to produce nanocluster structures and improve the properties of metallic glasses.

Aronin and Abrosimova [4] present a brief overview of the structure and properties of amorphous–nanocrystalline metallic alloys. The transformation of a homogeneous amorphous phase into a heterogeneous phase, the dependence of the scale of inhomogeneities on the component composition, and external influences are considered. The mechanical properties in the structure in and around shear bands are discussed.

Permyakova and Glezer [5] present a detailed study of the preparation method and specific features of the changes in the structure and properties of amorphous–nanocrystalline composites formed by high-pressure torsion of melt-quenched iron- and cobalt-based amorphous ribbons and Cu–Nb crystalline nanolaminates.

Abrosimova et al. [6] studied the devitrification of $Zr_{55}Cu_{30}Al_{15}Ni_5$ bulk metallic glass upon annealing and high-pressure torsion deformation. They found the formation of different crystalline phases upon heating and deformation. At the first crystallization stage, a metastable phase with a hexagonal structure is formed. A further temperature rise results in the formation of stable crystalline phases. It was determined that nanocrystals upon deformation are formed primarily in the subsurface regions of samples.

Liu et al. [7] studied the mechanical relaxation behavior of La-based metallic glasses probed by dynamic mechanical analysis. They found that the intensity of the secondary β relaxation decreases after physical aging below the glass transition temperature, which is probably due to the reduction in the atomic mobility induced by physical aging.

Khonik and Kobelev [8] present a brief overview of the Interstitialcy theory as applied to different relaxation phenomena occurring in metallic glasses upon structural relaxation and crystallization. The basic hypotheses of this theory and their experimental verification are briefly considered. The main focus is given to the interpretation of recent experiments on the heat effects, volume changes, and their link with the shear modulus relaxation.

Makarov et al. [9] apply the Interstitialcy theory to show that the kinetics of endothermal and exothermal effects occurring in the supercooled liquid state and upon crystallization of metallic glasses can be well-reproduced using the temperature dependences of their shear moduli. They argue that the interrelation between the heat effects and shear modulus relaxation reflects the thermally activated evolution of an interstitial-type defect system.

The paper by Wang et al. [10] reports on a new type of Mg-based metallic glass, which demonstrates excellent corrosion resistance and favorable biocompatibility. In their study, the authors prepared amorphous/crystalline composite Mg–Rare Earth alloy sheets by a twin roll caster method and studied their corrosion resistance behavior. The samples were implanted into the femur of rats to study its prospect as biological transplantation material. The experiments showed that Mg–RE (La, Ce) sheets have good corrosion resistance and, as an implant material, induce new bone formation, which is why they can be considered as a promising implant material.

**Conflicts of Interest:** The author declares no conflict of interest.

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