Metallic Glasses: Structural and Biomimetic Materials

Jiri Orava*

Faculty of Environment, J. E. Purkyne University in Usti nad Labem, Pasteurova 3632/15, Usti nad Labem 400 96, Czech Republic (jiri.orava@ujep.cz)

Metallic glasses (MGs) are essentially frozen metallic liquids formed upon rapid quenching. Unlike the liquids, MGs have resistance to shear deformation and are of fundamental and technological interest because of large reversible elastic energy storage, high hardness giving good wear resistance, and high toughness, which can be combined with other functionalities such as low-loss soft-magnetic properties, biocompatibility as (non)-degradable implants, or potentially as aesthetic beauty products (**Figure 1**) and/or cases for electronics because of defect-free growth of compact oxide.

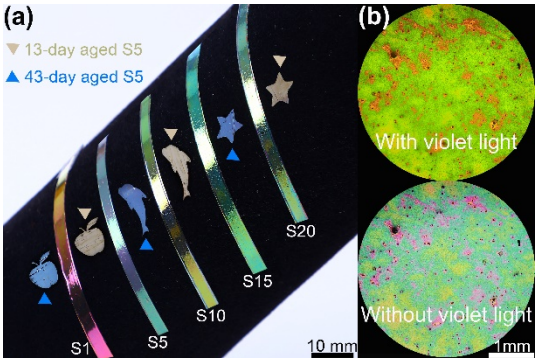

Figure 1| Beauty-like products made of spontaneously-oxidized Ce-based metallic glasses.[1]

In general, MGs suffer from poor plasticity/ductility which limits their applications as structural materials and mechanically-stressed implants. The initial plastic deformation in MGs is localized in atomic-size partially-reversible shear-transformation zones, which upon continuous deformation transform into shear band(s) and whose, when initiated, self-propagating mechanism results in MGs catastrophic failure. We will demonstrate, among other methods, two ways of enhancing the MGs plasticity either by stimulating inherent heterogeneities via non-affine thermal strains or by introducing crystalline inclusions giving glass—crystal composites.

We will give an overview of the application field of MGs with special focus on structural and biomimetic applications.

References

[1]P. F. Wang, H. Y. Jiang, J. A. Shi, M. Liu, L. Gu, W. Zhou, J. Orava, Y. H. Sun, W. H. Wang and H. Y. Bai, Regulated color-changing metallic glasses. *J. Alloys Compd.* **876**, 160139 (2021).