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Characterization of the stress-temperature-time relaxation spectrum of metallic glasses*E. Pineda*¹, *F. Yang*²¹ *Departament de Física, Universitat Politècnica de Catalunya*² *Institut für Materialphysik im Weltraum, Deutsches Zentrum für Luft- und Raumfahrt (DLR)*

The mechanical and rheological properties of metallic glass-forming alloys are directly related to their relaxation spectrum. Together with the main structural α -relaxation, metallic glass formers show secondary relaxations of various kinds. Some of these secondary processes have been associated to the Johari-Goldstein relaxation but also to other origins [1], the activation of these processes depends on temperature as well as on the applied stress level [2]. In this work, stress relaxation, creep and mechanical spectroscopy experiments have been performed on vitreloy4, a well-known, high glass-forming-ability alloy, with the purpose of obtaining an unprecedentedly detailed stress- temperature-time relaxation map. The characterization covers a wide range of temperatures, from room temperature ($\sim 0.5T_g$) to $1.15T_g$, and times from 10^4 to 10^{-3} s. The stress domain was explored by stress relaxation and mechanical spectroscopy applying deformations going from 0.005el to 0.5el (el \sim 2% the elastic limit typical of metallic glasses). Furthermore, below T_g , in the glassy state, the relaxation map was obtained for different fictive temperatures.

The observed relaxation processes were classified in terms of their anelastic (reversible) or viscous- like nature, with characteristic times showing very different temperature dependences. The relative contribution to stress relaxation of each type of process was found to be dependent on both temperature and stress level. In addition to the detailed description of the stress-temperature-time relaxation map of vitreloy4, we will interpret the results in terms of the current metallic-glass relaxation models and the relaxation spectrum obtained in other metallic glasses [3]. Finally, we will discuss what processes are expected to be universal of all glass formers and which are characteristic of certain metallic systems.

[1] B. Ruta et al., *J. Phys. Condens. Matter* 29 503002 (2017); P. Luo et al., *Phys. Rev. Lett.* 118, 225901 (2017)

[2] E. Pineda et al., *Acta Mater.* 61, 3002 (2013)

[3] C. Liu et al., *J. Alloys Compd.* 643 S17 (2015); C. Liu et al., *J. Phys. Chem. B* 120, 2838–44 (2016)