Bulk metallic glasses formed by supercooling the liquid state of metallic alloys have potentially superior mechanical properties than those of crystalline materials, such as high strength and large elastic strain. The main issue for metallic glass is the formation rapid shear banding, significantly reducing their structural applications. Recently, it has been demonstrated this issue can be contoured when the size is reduced [1, 2]. Thermal evaporation is used as a way to growth thin films, and in specific cases, it can be used to growth of metallic glasses. In this work, thin films of Ti:Si alloys were produced by thermal evaporation. An extensive study of this material was performed using transmission electron microscopy (TEM) and atomic force microscopy (AFM). Thin Ti:Si alloys support films for electron microscopy were prepared by coating standard EM grids with evaporated films floated off mica. The mechanical stability of films was followed by eye when the film floated in the water and also checking the cover of the film in the TEM grid. We have grown Ti:Si alloys where the composition was varied from 5% of Ti to 95% of Ti. The films composition was double-checked by Energy Dispersive Spectroscopy (EDS) and Electron Energy Loss Spectroscopy (EELS). Transmission electron image and electron diffraction were used to check the crystallinity of the films (Figure 1). Ti:Si alloys films presented a polycrystalline structure or metallic glass structure depending on the composition. The roughness surface and thickness of Ti:Si films were measured by Atomic Force Microscopy (AFM). At room temperature, the specific resistance of the films was followed by four-probe method. Finally, the oxidation of films was measured by EELS (Figure 2).

References:

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Fig. 1: Selected Area Electron Diffraction of a) Ti$_{95}$Si$_{5}$ thin film and b) Ti$_{70}$Si$_{30}$ thin film. Ti$_{95}$Si$_{5}$ sample showed polycrystalline diffraction pattern and Ti$_{70}$Si$_{30}$ an amorphous pattern.

Fig. 2: EELS Spectrum of a) Ti L edge and O K edge of Ti$_{95}$Si$_{5}$ thin film and b) Si L edge of Ti$_{70}$Si$_{30}$ thin film. Ti$_{95}$Si$_{5}$ sample showed a characteristic EELS Spectrum of TiO$_2$ while Ti$_{70}$Si$_{30}$ showed a Si pure.