Multiscale characterization of the wettability of fs-laser textured thin film metallic glasses surfaces

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With the absence of crystalline defects and their amorphous structure, metallic glasses (MGs) exhibit very interesting mechanical and chemical properties. They have been studied since the 60s in their bulk state (BMGs), but are size limited and complex to synthesize due to their high needed number of elements. More recently, PVD processes enabling high cooling rate of the deposited atoms have demonstrated the easier formation of metastable amorphous metallic phases, together with great freedom in the films' chemistry.
From pure metallic targets, the magnetron sputtering process has already shown its ability to synthesize binary Zr-Cu thin film metallic glasses (TFMGs) over a wide range of chemical compositions (from 13 to 85 at.% of Cu [1]), with low surface roughness together with the absence of grain boundaries, making them suitable for a femtosecond laser treatment [2], to further improve their properties.
The work proposed here considers the formation of laser induced periodic surface structures (LIPSS) at the surface of two ternary magnetron sputtered TFMGs (ZrCuAg and ZrTiAg, with interesting biological properties [3]) using infrared ultrashort laser treatment. These textured surfaces are first studied in terms of topographic and chemical modifications, then a focus on the wettability modifications (hydro-phily/phoby) is proposed. Wettability is studied first at the macroscale from the conventional measurement of the water contact angle. On the other hand, the condensation process of water onto the surface is also measured at the microscale by in situ measurements conducted in an environmental scanning electron microscope (ESEM). Such a complementary small-scale method gives key information on the interaction of very small water droplets with the textured surface, opening the way to biological behavior of such surfaces.

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[3] A. Etiemble, et al., "Innovative Zr-Cu-Ag thin film metallic glass deposited by magnetron PVD sputtering for antibacterial applications", Journal of Alloys and Compounds, 2019

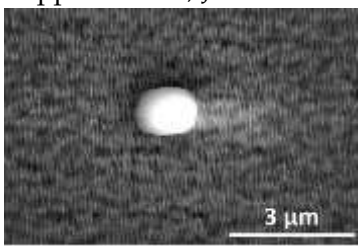

Figure: Image of a droplet in ESEM condensing on a femtosecond textured $ZrCu_{(65/35)}Ag_4$ TFMGs.