NANOMECHANICAL BEHAVIOR OF BIODEGRADABLE METALLIC GLASS FOR TRANSIENT ELECTRODES

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Key Words: metallic glass, nano tensile test, biodegradable metal, stretchable electrode, thin film mechanics

Transient electronics is emerging concept of biodegradable electronic device that naturally dissolves by ground water or biofluid after their function ends. This new type of electronics provides the potential application of wearable and/or implantable device in zero-waste disposable electronic patch or secondary-surgery-free biodegradable implants. The large stretchability of such device is essential to maintain the mechanical match to largely deformable and soft skin and tissue. Here we investigated the biodegradable metallic glass consisted of biodegradable metal element (Mg, Zn, Ca) to exploit the large elastic strain of amorphous metal. Nano tensile test was performed to compare the stretchability of MgZnCa metallic glass to Mg polycrystalline. Yield strain of metallic glass was ~62% larger than one of Mg, of course, but the total elongation of metallic glass was also ~45% larger. The small number of grain of thin film Mg may limit the plastic deformation and cause the brittle deformation unlike macroscopic condition. Overall the MgZnCa metallic glass showed the superior yield and elongation and improved the stretchability of biodegradable metallic electrode. Combining the serpentine structure the stable operation of LED interconnected with MgZnCa metallic glass was available up to 130% strain. Series of demonstration of MgZnCa based transient device supports the stretchable and biodegradable electronics in eco/bio-friendly applications.

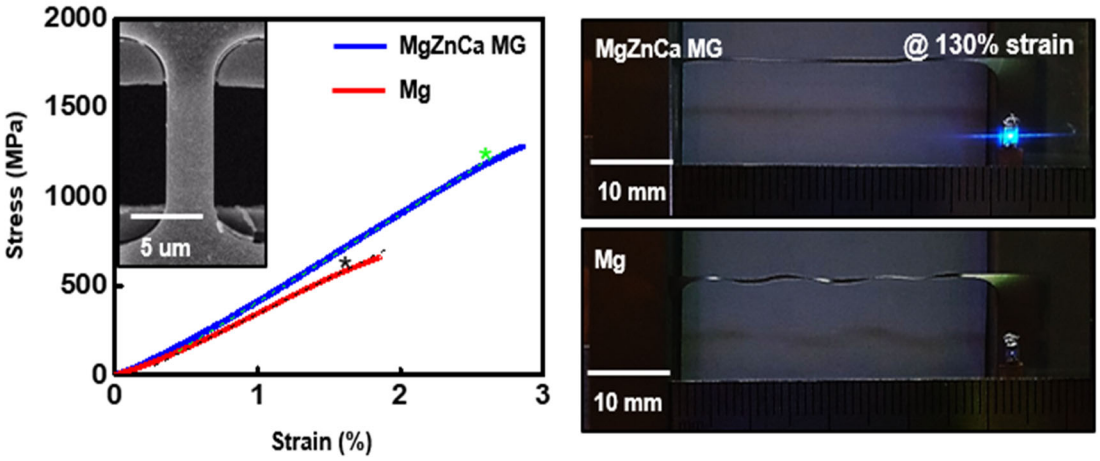

Figure 1. Stress-strain curve of 300 nm thickness freestanding MgZnCa MG and Mg film (Left). Stretchability of MgZnCa MG (300 nm) /PBAT (100 μm) hybrid layer with serpentine shape structure (Right).[1]

Reference
[1] J.-Y. Bae, E.-J. Gwak, G.-S. Hwang, H.W. Hwang, D.-J. Lee, J.-S .Lee, Y.-C. Joo, J.-Y. Sun, S.H. Jun, M.-R. Ok, J-Y. Kim, S.-K. Kang, Advanced Science, 8(10), 2004029 (2021).