Bulk Metallic Glass Gears for Lunar Night Capable Actuators. R.P. Dillon[1], J-P.C. Borgonia[1], S.N. Roberts[1], D.C Hofmann[1], A. Kennett[1], S.A. Firdosy[1], B.H. Wilcox[1], S. Hales[2], J.D. Smith[3], J. Schuler[3], B. McEnerney[1], and A.A. Shapiro[1]
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Introduction: The Bulk Metallic Glass (BMG) Gears project is a NASA Game Changing Development project that has been co-funded by the Space Technology Mission Directorate and Science Mission Directorate to develop unheated, cold capable, BMG-based gearboxes (Fig.1) for use in cryogenic environments such as Lunar night. Cryo-environment capable gearboxes which do not require ancillary equipment, including the heaters and associated circuitry, found on current state-of-the-art cryogenic gearboxes are enabled by a CuZr-based bulk metallic glass (BMG) alloy. This alloy exhibits surface wear behavior ~1/3 that of maraging steel. In this poster, the enabling alloy properties and cryogenic test performance, both unlubricated and dry lubricated, are considered relative to the current state-of-the-art. Component processing, material qualification, technology readiness, and infusion challenges are also presented. Background on the early development of BMGs for gearbox applications has been published in [1] for planetary gears and [2] for strain wave gears.

Fig 1. BMG-based planetary gearbox

References:

[1] Hofmann, DC et. al, Advanced Engineering Materials (2016) DOI: 10.1002/adem.201600541

[2] Hofmann, DC et. al, Scientific Concepts (2016) DOI: 10.1038/srep37773