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AUTONOMOUS ROBOTICS POWERED BY FLEXIBLE NANOCOMPOSITE BATTERIES WITH HIGH ENERGY DENSITY

Abstract

Purpose: Space missions nowadays rely on autonomous robots which either land on the planetary surface for exploration missions, or carry a repair job outside the space station. Such autonomous robots in many cases need a spike in energy consumption while carrying complex mechanical/electrical and engineering jobs, such as drilling, moving or flying to large distances, heating some subjects, or hitting/cracking specific targets. In some cases autonomous robots rely on the solar energy stored in station/satellite batteries, however, in many specific cases they need their own energy source independent from the satellite/station batteries. Methodology: We propose the usage of flexible nanocomposite batteries based on polar polymers with high-k dipolar inclusions (perovskite materials), which possess high-density energy storage capacity, and can deliver short-time high-energy pulses as super-capacitors, for maintaining different crucial jobs. Results: BaTiO3 dipolar inclusions in the PVP matrix were investigated at different inclusion packing fraction and under different applied ac fields. Using BDS measurements we calculated polarization hysteresis loops for these nanocomposites, and defined the optimal packing fraction and grain size at which the energy storage is maximal. Deconvolution of the hysteresis loops also gave us crucial information about the dipolar correlations in the composite, which appears to be the main contribution to the losses. Smaller grain sizes decrease these losses. Conclusions: We show that flexible nanocomposite materials with perovskite particle inclusions in the PVP matrix have high energy storage density and can be used for powering autonomous robots in space missions. Areas for discussion: These polymeric nanocomposites, when wrapped by flexible solar panels, will be continuously charged and ready to deliver huge charge pulses because of their high energy density. For planetary missions this is a reliable energy source for autonomous robots.