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Dielectric elastomer artificial muscles

Chiba S
Chiba Science Institute, Japan

Growth in world population and further industrialization combined with concerns about global climate change is causing a surge in demand for clean and renewable energy. We discuss the potential of Dielectric Elastomers (DEs), a new energy transduction technology that can be used to harvest energy from the environment or human activities as well as save energy by making light and efficient motors and other devices. At the material level, this material has fast speed of response (over 100,000 Hz has been demonstrated for small strains), with a high strain rate (up to 640%), high pressure (up to 8 MPa), and power density of 1 W/g (for comparison, human muscle is 0.2 W/g and an electric motor with gearbox is 0.05 W/g). Currently, research is moving from the development stage into the commercialization stage through establishment of practical applications. Using a DE actuator makes it possible to achieve a highly efficient transduction from electric energy into mechanical energy, which translates into a considerable energy saving compared with other actuator technologies such as electric motors with gearboxes. Furthermore, its low cost, light weight, softness, and quietness make the actuator suitable for robots, sensors, motors, speakers, pumps, smart materials, and a wide range of other uses that are currently under development. DE has a very simple structure comprised of a polymer film (elastomer) sandwiched between two electrodes made of a flexible and elastic material. Applying a voltage difference between the two electrodes causes a compression in the horizontal direction and a stretching along the surface. Until recently, the possibility of using DE for electricity generation (energy harvesting) was not well known compared with actuator mode. The operating principle for the electricity generator is rather simple. The DE generator mode uses the actuator mode process in reverse, transforming mechanical energy originating from the physical deformation of the film into electrical energy

e: epam@hyperdriveweb.com