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Chiba S

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Biography

Chiba S was Executive Director for Advanced R&D Project Development, SRI International. He served on SRI for 22 years. He was supervising advanced R&D programs including Japanese Government projects. Currently, he is CEO and Professor, Chiba Science Institute. He has published more than 367 papers in the various areas and has been serving as Editorial Board Member of AWMC, Industrial Engineering and Management, Industrial Engineering and Management, Steel Structures and Construction, and Journal of Material Science. He has a PhD in Metallurgy and Material Science from the University of Wales.

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ELECTROACTIVE POLYMER TRANSDUCERS

Electroactive polymer transducers have many features that are desirable for various devices. An especially attractive type of electroactive polymer is dielectric elastomer (DE). DEs are a new type of transducer technology that were first investigated by SRI International in 1991. 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. As elastomers are light and deform like rubbers, they can show flexible movements like bionic actions. They can express "flexible and natural feeling" which systems with motors cannot imitate. In addition to above, DE actuators do not use any gears and cams, thus enabling high efficiency and safe and smooth driving even if the speed or direction of movement are suddenly changed. Using DE elements, a variety of devices can easily be made, such as linear actuators, diaphragm actuators for fluid pumps, and actuator arrays. Its low cost, light weight, softness, high efficiency, and quietness make the actuator suitable for robots, motors, speakers, and smart materials. The DE actuator has a fast speed of response (over 100,000 Hz has been demonstrated for small strains), with a high strain rate (up to 600%). Our recent progress is a DE actuator having only 0.1 g of DE that lifted a weight of 22N using single CNT electrodes. This is suitable for the hands or feet of robots. We also developed a ribbon form DE actuator having a sensor function that can be used to measure force, or pressure, as well as motion at the same time. This actuator can assist human and robot motions. At the same time, it can work as a motion feedback sensor. We hope that it may be useful for smart rehabilitation equipment for hands, legs, and fingers. DE has also been shown to operate in reverse as a generator. Experiments have been performed on portable DE generators powered by human motion, ocean wave power harvesters mounted on buoys, solar heat generators, and water turbines. The power output levels of such demonstration devices are small now. However, the performance of these devices has supported the potential benefits. We are starting to develop elastomers having larger dielectric constant to produce a "super artificial muscle for excellent sensors, powerful energy harvesting devices, and DE motors can drive vehicles.

Note:

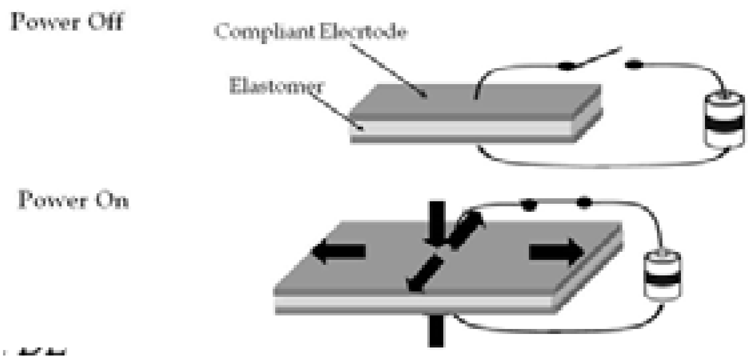

Fig.1: Principle of operation of DE actuators.

Recent Publications

1. S Chiba et al (2016). Elastomer Transducers (2016). Advances in Science and Technology. Trans Tech Publication, Switzerland. 97: 61-74.
2. Chiba S et al (2017). Experimental study on the motion of floating bodies arranged in series for wave power generation. Journal of Material Science and Engineering A7. 11-12: 281-289.
3. Chiba S et al (2017). Simple and robust direct drive water power generation system using dielectric elastomers. Journal of Material Science and Engineering B7. 1-2: 39-47.

Note: